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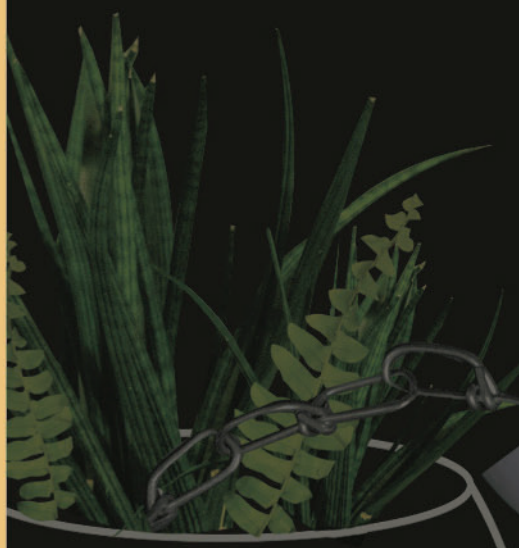
MURR

Mountaineer Undergraduate Research Review



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Volume 6

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Issue 1

THE MOUNTAINEER UNDERGRADUATE RESEARCH REVIEW

Volume 6, Issue 1, June 2021
West Virginia University
The Office of Undergradaute Research
Morgantown, West Virginia

The Mountaineer Undergraduate Research Review (MURR) publishes outstanding research performed by undergraduates at West Virginia University. MURR is published under the auspices of the West Virginia University Office of Undergraduate Research. Digital copies of MURR are published on the Research Repository @ WVU website (https://researchrepository.wvu.edu/murr). Papers are reviewed by qualified faculty members at WVU, and are reviewed and edited by a student Editorial Review Board. Questions about MURR should be submitted to murr.wvu@gmail.com or resolved by visiting the journal webpage (https://undergraduateresearch.wvu.edu/present-and-publish/murr).

Cover Synopsis: Illustration by Megan Rinker

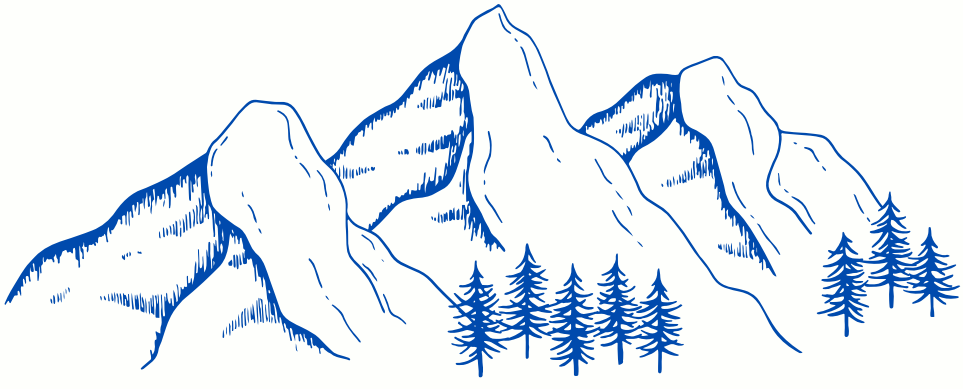
My artwork reflects the multiple types of disciplines involved in the undergraduate research process, merging STEM, art, graphic design and the brainstorming process into one collage. It exemplifies the trial and error with the research process, that it is not linear and can be messy or involve many components, and how the reward of further gained knowledge is always on the horizon. I created this piece to display how multiple disciplines and majors might combine in the research process and enrich undergraduate studies as a whole through the combined knowledge we gain from each of our areas of study. The path we take to researching a subject is not always linear or clear, and it can be very long and intense; but the process itself of research is a method of creating a new path that has yet to be explored before.

I incorporated hand painted elements along with digitally created collages, and I added coding language such as binary or hex codes to imitate annotations and notes one might take when compiling research information and the contrasts between research in the arts & humanities and STEM. The elements such as the hand with the pencil or the head with blooming plants imply not only the hard work and countless hours put into writing and researching, but the information that is gained by dedicating oneself to a field of study and the benefits it has on a group or individual. I believe for this undergraduate research journal that this piece will enhance it by showing the non-linear path it takes to create an artwork, let alone a research study; no matter how chaotic or frustrating it may seem with all of its moving pieces, the end result is always something worth being proud of accomplishing.

Opening Regards

Congratulations to all of the undergraduate students for completing another excellent edition of Mountaineer Undergraduate Research Review (MURR)! You should be incredibly proud of yourselves and of your work. I am honored to bring you these greetings. The WVU Research Office is excited to support this work, as the ability to conduct world class, publishable research with an engaged faculty mentor is what sets a WVU undergraduate education apart. Publishing in MURR is competitive and fully peer reviewed – by both students as reviewers, as well as faculty member content experts. If one has a piece published in the journal – rest assured you are among the best of the best. I would also like to offer a heartfelt thank you to all of the students who make MURR possible – it is no small feat to undertake the entire publishing process for a journal (and doing it on top of full course loads and often conducting your own undergraduate research). Just being able to participate in undergraduate research opens doors for students and being able to publish that work takes it to the next level – the fact that so many students are willing to put the time and effort into MURR to benefit their fellow students is exactly what being a Mountaineer is about. On behalf of the WVU Research Office, thank you and congratulations again on another excellent Review!

Dr. Melanie Page
Associate Vice President for Creative and Scholarly Activities
WVU Research Office



Opening Regards

Dear Mountaineers,

The ASPIRE Office is proud to support the 6th publication of the Mountaineer Undergraduate Research Review (MURR). We value our strong partnership with the Office of Undergraduate Research (OUR) and our shared commitment to enhancing out-of-classroom learning opportunities for our students. It is an honor for us to write this welcome letter.

Research is one important way for students to maximize their educational experience at West Virginia University. It allows them to deeply explore an interest and learn how to problem-solve. Research helps them strengthen their creativity, resourcefulness, and critical thinking. It gives them an opportunity to work closely with a mentor and a team to tackle a challenge. These are critical skills for students to gain during their time at West Virginia University.

On a personal note, both Cate and I credit our own undergraduate research experiences as fundamental to our academic paths. Cate traveled to Uganda in 2006 to study displaced persons in post-conflict Northern Uganda with the guidance of a mentor. That first experience sparked her life-long passion for international travel and studying development in post-conflict communities. Amy worked with a professor in the English department coding the body language of coal miners who were recorded talking about their jobs as a way of examining their understanding of risk.

In addition, we see the importance of undergraduate research in our day-to-day work with students who are applying for nationally competitive scholarships and fellowships. Each award we work with highly values research experience for students. A deep research experience often sets a student apart from their peers; it is a concrete way to demonstrate passion for a subject, commitment to a project, and flexibility to adapt when needed – all qualities that our best and brightest students possess.

We are thrilled to see students actively engaging with research topics in this volume of MURR. We know that these student researchers tend to be the leaders in their fields who will continue to make discoveries and advance our collective human knowledge. Finally, thank you to their faculty research mentors and advisors who generously take care and time to teach our students the art of discovery.

In closing, we encourage our student researchers to continue their quest for knowledge so that we can better tackle the many challenges facing our world. We are proud of the work you do and proud to be part of the team at West Virginia University supporting your research endeavors!

Amy Cyphert
Director, ASPIRE Office

Cate Johnson
Assistant Director, ASPIRE Office

Contents

Preliminary Assessment of Climatic Sensitivity of Riparian Old-Growth Eastern Hemlock

John B. Holden IV, Sophan Chhin, Andrew Hirsch, Eric Yetter

West Virginia University Division of Forestry and Natural Resources

Eastern hemlock is a long-lived, slow growing climax species in North America currently undergoing a major decline in population due to a combination of effects derived from hemlock woolly adelgid (HWA) as well as changing climate patterns. Data was collected in an old-growth, riparian hemlock forest within the West Virginia University Research Forest to understand the effect of monthly climate factors (mean temperature, mean precipitation, and climate moisture index (CMI)) on hemlock radial growth. Results indicated that March mean temperature and May CMI of the current growth year are positively associated with hemlock growth whereas prior year summer conditions of each climate variable resulted in negative correlations. Spring temperature as well as winter precipitation of the current year also lessened hemlock growth. Many of the significant relationships ascertained by this study were well supported by other studies; however, increased June precipitation and CMI resulting in a reduction in growth may be explained by summer storm damage or root anoxia, resulting in lessened growth1, 2. Also, previous studies conducted south of the study area found winter precipitation to positively affect growth; this incongruence is explainable by differences in precipitation types and how heavy snow could contribute to hemlock damage2. Through the establishment of these relationships, it may be better understood how riparian, old-growth hemlock stands within central Appalachia will respond to changing monthly climate patterns.

Introduction

Eastern hemlock (Tsuga canadensis) is an important tree species found within the Northeast, Great Lakes, and Appalachian regions of the United States. It is noted for being an exceptionally long-lived foundational species, often taking hundreds of years to mature. Hemlock stands are unique in that they create a cool, moist microclimate that is conducive to deep organic soils associated with slowed decomposition[3]. The riparian nature of the stand examined in this report is consistent with eastern hemlock's favorability for the aforementioned climate conditions. The microclimate of hemlock, when paired with increased coarse woody debris retention derived from an old-growth structure, could allow for enhanced understory vegetation biodiversity[4].

Less than 1% of old-growth hemlock stands within the Appalachian region still exist[5, 6]. With the emergence of a deadly invasive insect, hemlock woolly adelgid (HWA), and changing regional climate, the decline of hemlock is expected to increase dramatically over the next century[7]. This depletion of a foundational species can significantly affect ecosystem function through altering forest carbon cycling, hydrology, and nutrient cycling; as well as by shifting species composition to better represent trees that are less sensitive to moisture stress (mesophytes)[3,8].

Current projections estimate that over the next century, the northeastern United States will see an increase of 2.9-5.3 degrees C in annual surface temperature with minimum winter temperatures expected to increase anywhere from 2.6 to 15.1 degrees C by 2081-2100[9]. This is significant in that HWA survivability is highly limited by winter minimum temperature[9]. Increased levels of CO2 within the atmosphere have allowed for a projection of increased tree growth with hemlock displaying a change in gas exchange behavior[10]. Warming air temperatures

associated with anthropogenic climate change have also been found to potentially increase hemlock radial growth; however, this effect is likely to be confounded by increased HWA activity associated with enhanced survival during winter months[1]. This appears to be most apparent in high elevation sites, as well as hemlock's northern range, due to spread of HWA being restricted by these low winter temperatures[11]. Hemlock found within the southern limit of its range appear to be most sensitive to moisture stress[2].

The key objective of this study is to examine the climatic sensitivity of a central Appalachian old-growth hemlock stand in proximity to a stream. Through utilizing hemlock cores and monthly climate data, this study aims to analyze climatic factors in relation to hemlock radial growth. This will give researchers a better understanding of how changing climate and pest invasion affect old-growth hemlock-hardwood stands within this region over the next century.

Methods

Field Sampling

Field data was collected in the West Virginia University Research Forest approximately 10 miles outside of Morgantown, WV at an elevation near 600 meters. Specifically, we sampled in the Hemlock Trail area - a stand of old-growth hemlock trees bisected by a stream. HWA has been detected at this site; however, the level of infestation is low. Inventory data was collected in August of 2019 with a total of five east aspect, 1/10th acre circular plots examined in this report. The plots were selected so that they were roughly at the same latitude, with a half-chain (1 chain = 66 feet) buffer from the stream, and at least a 3-chain buffer between plots. This study was considered to be preliminary as a limited number of plots were sampled.

Overstory data was collected at each plot by sampling trees ≥ 4" in diameter at breast height (DBH), or 4.5 feet. Within each plot, four eastern hemlocks were randomly selected, with an additional hemlock with the largest DBH selected for dendroclimatological analysis (for a total of five trees). Cores were taken at breast height on both northern and southern faces of each tree for a total of 10 cores per plot. Inventory data was then used to calculate trees per acre as well as basal (cross-sectional) area per acre values across diameter size classes.

Sample Processing

Cores were prepared for analysis by drying, mounting, and progressively sanding cores to 400 grit. Cores were then dated using the visual cross-dating approach known as the list method[12]. Cores were scanned at 2400 dpi and analyzed using the program "CooRecorder", a program used to measure the width of each annual ring, where measurements are saved into position files[13].

Statistical Analysis

Position files were then converted to rwl decadal files using the program "CDENDRO" so that ring width measurements could be further analyzed using program "COFECHA", a statistical program designed to determine cross-dating accuracy through establishing intercorrelation values between sample measurements[13, 14]. Ring width measurements were then standardized in program ARSTAN, using a 40-year cubic spline to eliminate growth variability due to tree aging or closed-canopy competition in order to create a residual chronology (autocorrelation removed) to be examined with climate variables[15].

Climate data was procured with PRISM climate group software to determine monthly climate variables for the geographic centroid (39.66053, -79.73631) of the study area[16]. Climate variables used in dendroclimatological (the science of using tree rings to reconstruct past climate) evaluation were maximum, minimum, and average monthly temperatures as well as monthly precipitation. These values were then used to calculate climate moisture index (CMI) through determining potential evapotranspiration (PET)[17]. CMI is a function of

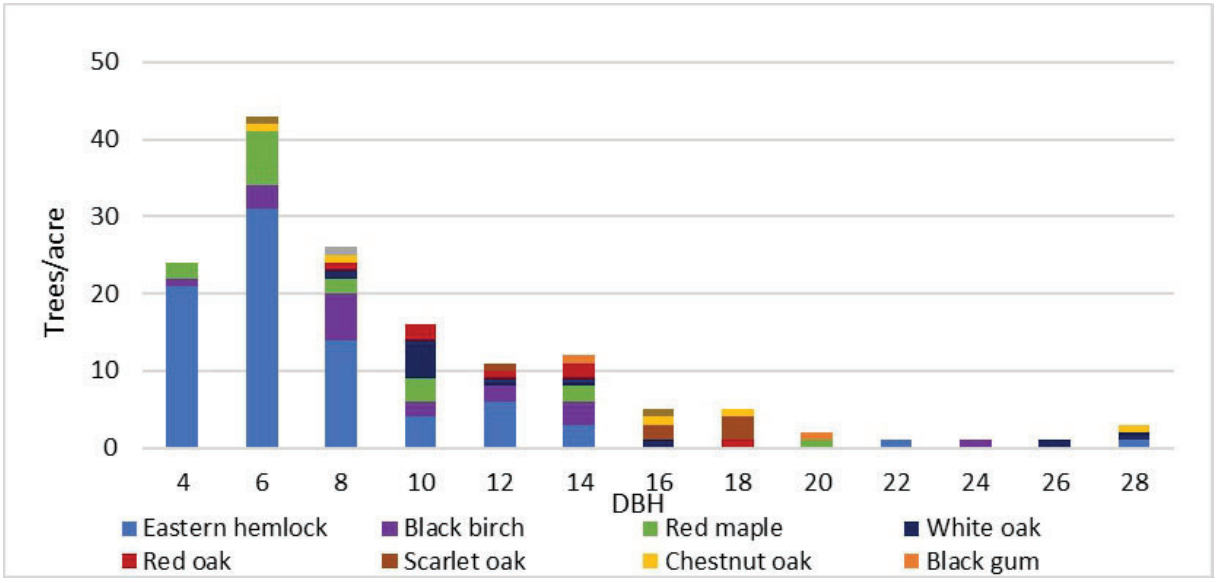


Figure 1: Diameter distribution of two-inch diameter classes.

monthly PET, precipitation, and elevation factors; this allows for concurrent analysis of these variables as an estimate of net water availability.

Using the program "DendroClim", we were able to analyze how mean temperature, precipitation, and CMI affected growth from August of the previous year to October of the current year[17, 18]. In doing this, correlation values between radial growth and each monthly climate variable could be examined; a significant positive value indicates increased annual hemlock growth due to favorable climate conditions. Due to the chronology sample size being 50 cores from 25 trees, it was possible to analyze climate variables from 1959 to 2019 which had an expressed population signal value greater than 0.85[19].

Results

Plot inventory data was used to determine that the study area had 300 trees per acre and a basal area of 182.5 ft²/acre. On top of this, of the 150 trees sampled, 81 one of them were eastern hemlock (54%). Black birch and red

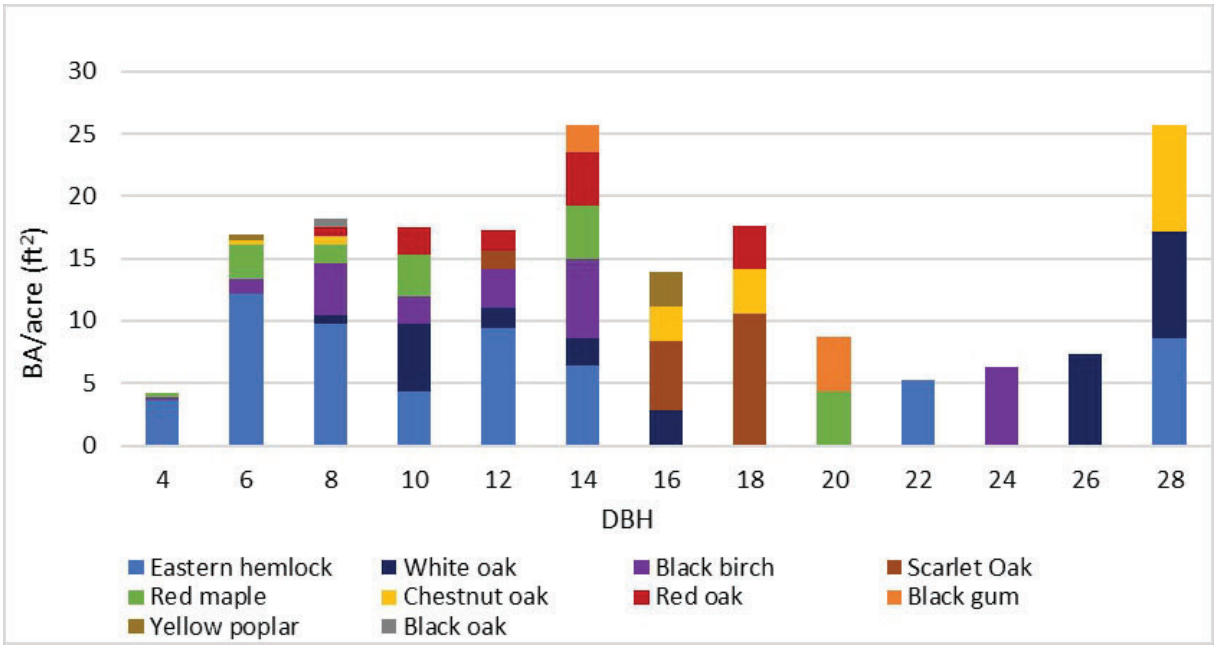


Figure 2: Basal area per acre (ft²) by species.

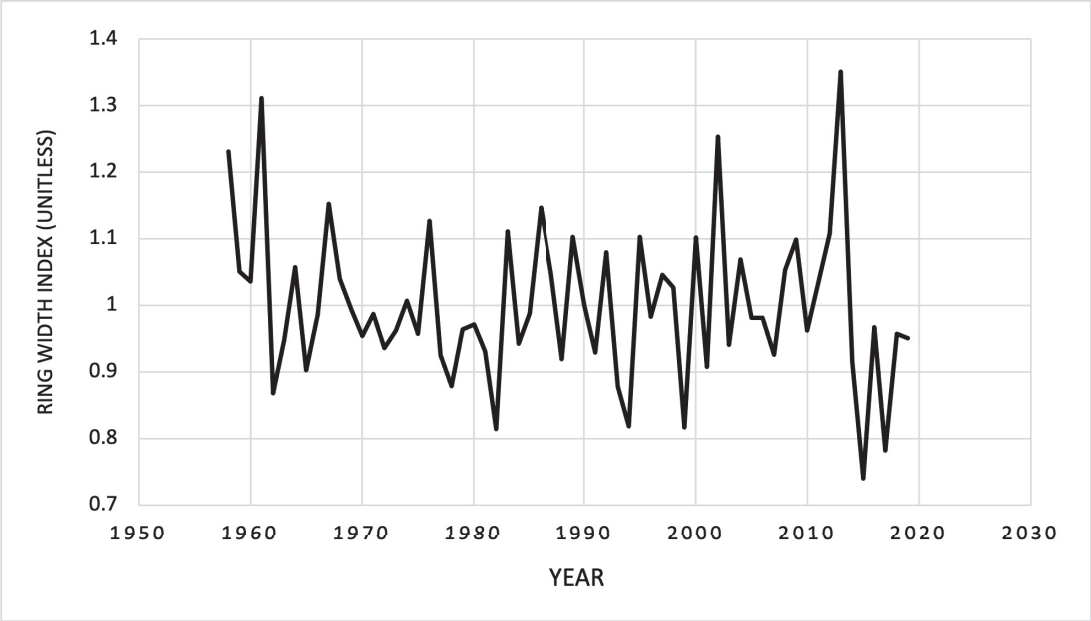


Figure 3: Standardized annual ring width chronology by year.

maple constituted 12% and 11% of the species composition, respectively. The rest of the stand was comprised of oak species (most notably, northern red oak, scarlet oak, and white oak) as well as small populations of black gum and yellow poplar. The diameter distribution of the stands was reverse-j in shape, which is characteristic of uneven aged h

emlock stands (Figure 1)[20]. *Figure 2* displays per acre values of basal area (ft^2) of all tree species within the stand across two-inch diameter classes.

After running core samples through COFECHA, series intercorrelation was determined to be well within the acceptable range at 0.495, this indicates strong intercorrelation among samples. Using program ARSTAN, mean correlation between trees was determined to be 0.36 with an agreement with the population chronology of 0.931. Mean sensitivity of the chronology displayed a value of 0.187. *Figure 3* displays the relative annual ring widths over the growth-climate analysis period (1959-2019).

Figure 4 displays the monthly correlation values between radial growth and mean

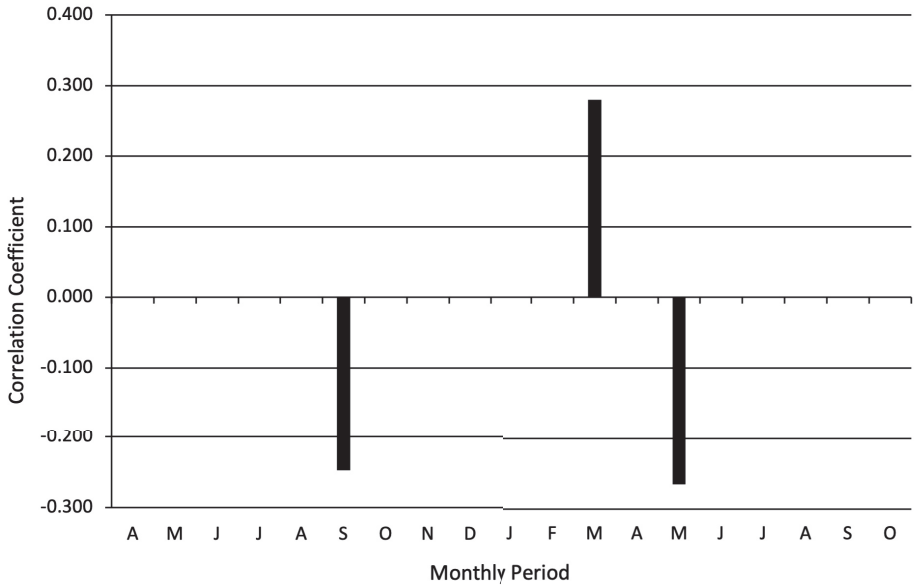


Figure 4: Correlation coefficients between radial growth and mean monthly temperature.

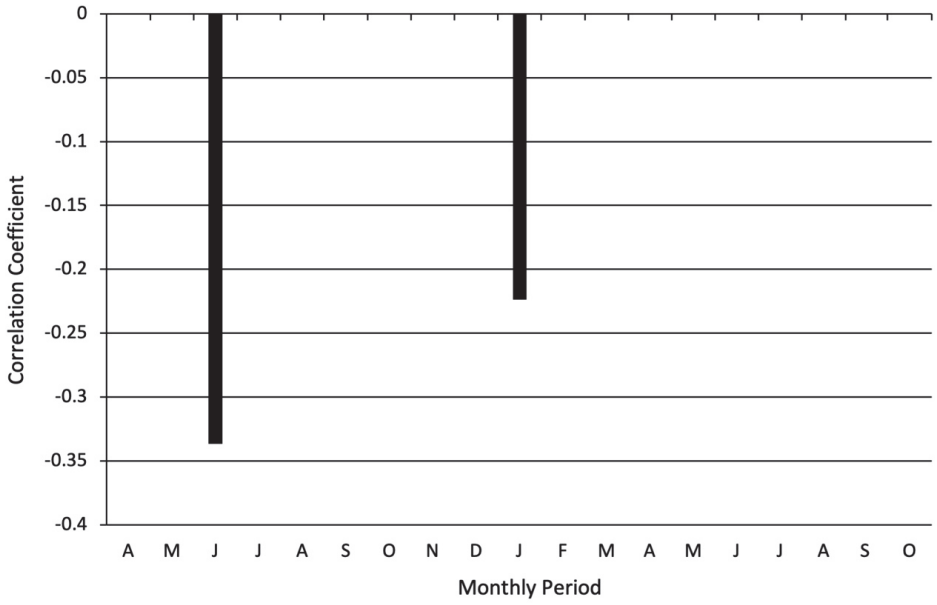


Figure 5: Correlation coefficients between radial growth and monthly precipitation.

monthly temperature of the previous and current year. Increased mean summer temperature was found to negatively impact hemlock growth with increased September temperature of the prior growing season and May temperatures of the current growing season correlating negatively at values of -0.25 and -0.26 respectively. Increased early spring temperature of the prior growing season correlated positively with a correlation of 0.28 in March.

Figure 5 shows the monthly correlation coefficients between annual radial growth and monthly precipitation of the previous and current year. Increased summer precipitation of the prior year was found to negatively impact hemlock growth at -0.34 correlation, while increased January precipitation also presented as a negative, significant correlation.

In *Figure 6*, previous and current year CMI values were analyzed with respect to hemlock radial growth. June of the prior year CMI values correlated negatively with growth at a correlation of -0.34; however, summer CMI values of the current year were found to be positively correlated (0.24) with growth.

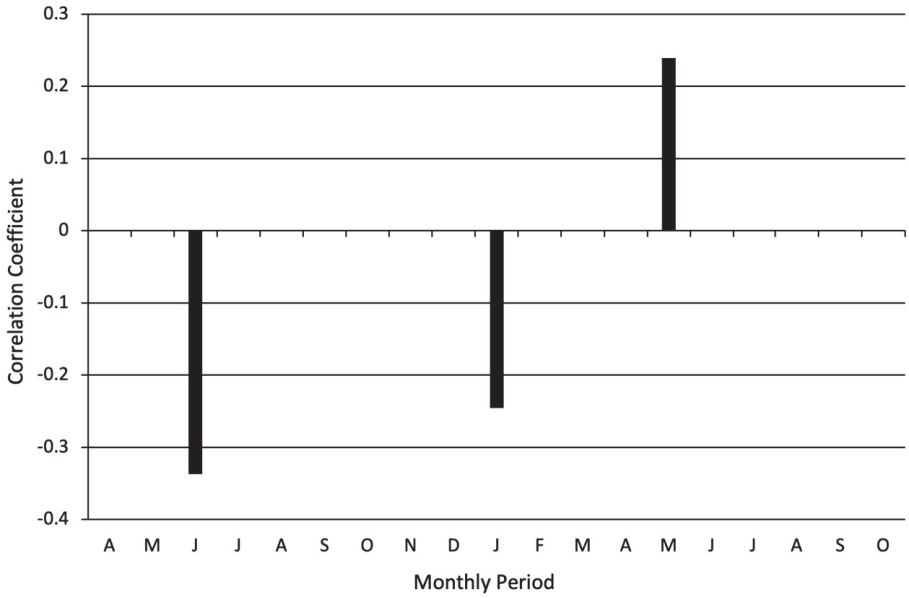


Figure 6: Correlation coefficients between radial growth and monthly climate moisture index (CMI).

Increased moisture availability in January of the current year was found to negatively correlate with radial growth (-0.24).

Discussion

Stand diameter was found to be reverse-j in distribution, which is in line with analysis of D'Amato et al.[20]. Further, a commonality between these studies can be drawn by considering both exhibited a greater range of representation among size classes as well as containing a high density of large trees. Meaning, this distribution is consistent with the complex structure of other old-growth hemlock stands brought about by gap-scale disturbance such as windthrow due to the shallow rooting nature of hemlock[21].

Species composition within the study area heavily favored eastern hemlock, accounting for 54% of all sampled trees. This is similar to other old-growth hemlock stands within northern West Virginia which exhibited a 60% hemlock representation in trees per acre[5]. Similarly, red maple and black birch exhibited 11% and 10%, respectively, in 2006[5]. This adds credence to the notion that hemlock stands within this region are likely to be replaced by these counterparts as red maple and black birch are already widely represented within the stand[3]. This has potential implications for carbon and nitrogen cycling rates as birch sequesters a greater amount of nitrogen (N) and less carbon (C) than hemlock with potential losses of 8% C uptake due to hemlock removal[11]. Organic mass has been found to be greater in hemlock plots than its mesophytic counterparts, perhaps due to a combination of hemlock microclimate and species biology[3]. Respiration rates are increased in birch stands, leading to potential implications for CO_2 source/sink dynamics[3].

Further, species composition within the study area indicates slow species composition shifts expected in riparian hemlock stands within central Appalachia[22]. HWA was first detected in northern West Virginia in 2002, where 4 years after infestation, hemlock stands within Cathedral State Park (CSP) had actually experienced an increase in hemlock representation by total tree count[5]. It is reasonable to deduce that the Hemlock Trail had not yet experienced a discernible change in hemlock density due to HWA invasion because of its riparian status and low level of infestation. This is inconsistent with many studies suggesting that hemlock mortality occurs within a timeframe of 4-10 years after infestation[23].

Significant positive radial growth relationships were determined in mean March temperatures (0.28) as well as in CMI in May (0.24) of the current year. A warmer early spring could allow for rapid utilization of stored resources through an early start in xylem tissue production in a season where moisture conditions are often favorable due to low evapotranspiration rates. Warm winter and spring temperatures positively correlating with short-term hemlock growth has also been found within old-growth hemlock stands by Bigelow et al.[1]. Heightened levels of CMI indicate greater water availability and thus, the results indicate that hemlock individuals exhibit increased growth due to greater water availability during early summer. These climatic factors are especially conducive to hemlock growth as the species tends to favor cool, humid sites[3].

However, significant negative growth relationships associated with elevated mean temperatures within the study area were determined in September of the prior year (-0.25) as well as May of the current year (-0.26). This may be an expression of moisture stress as the results indicate a positive correlation with May precipitation and CMI. A strong negative relationship has been found between hemlock growth and August of the prior year temperatures in southern hemlock stands[2]. A 2013 study conducted by Chhin et al. in northern, riparian white pine stands, found moisture stress derived from high mean summer temperatures negatively impacted growth[24]. With elevated temperatures within late summer months, drought stress may cause hemlock to reduce photosynthesis in order to limit stomatal conductance necessary for

carbon uptake.

This study suggests that precipitation factors were only found to have negative growth relationships with hemlock. June precipitation of the prior year provided a strong negative relationship (-0.34) as did January of the current growth year (-0.22). This relationship with June precipitation is in opposition to prior studies suggesting that high summer precipitation positively impacted hemlock growth[1]. The findings also suggested that June CMI of the prior year (-.34). negatively impacted growth. This may be caused by wind damage enacted on hemlock crowns during storms or the over saturation of the soil profile leading to root anoxia.

Enhanced levels of January precipitation in the current year may result in greater damage caused by snow or frost, explaining the reduction of growth for the current year as hemlock will expend growth resources to recover from damage or needle loss. However, it is important to note that precipitation outside of this range could heighten or diminish this effect due to variability in precipitation type outside of central Appalachia; winter rain would not have the same damaging effect as a snowstorm. This may be supported by a prior study conducted on hemlock growth at the southern limit of its range in that February precipitation of the current year encouraged growth[2]. The effect of differing precipitation types could have implications for determining the future southern extent of hemlock's range as well as how hemlock may adapt to changes in late winter or early spring precipitation types. A study conducted in the Northeast found that warm January temperatures increase the risk of basal area increment decline by 45% in HWA infested sites[25]. Increased survivability of HWA due to higher winter temperatures may produce an interesting dynamic with this potential pattern of shifting precipitation types.

This study determined that riparian, old-growth hemlock respond positively in radial growth to warm early springs due an early start in the growing season when water demand is low. Increased moisture availability in May of the current growing season was also found to be beneficial to hemlock growth. However, it was found that hemlock within this site were negatively impacted by increased temperature in September of the prior growing season as well as in May of the current season which may be caused by increased moisture stress[24]. Increased summer and winter precipitation were also found to negatively impact hemlock growth, perhaps due to precipitation damage or root anoxia from oversaturated soils.

Acknowledgements

This study was supported by the United States Department of Agriculture (USDA), National Institute of Food and Agriculture (NIFA), McIntire Stennis Project # 1017946, to S. Chhin.

Competing Interests

The author declares no competing interests.

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How to Cite This Article:

Holden IV, J. B., Chhin, S., Hirsch, A., & Yetter E. (2021). Preliminary assessment of climatic sensitivity of riparian old-growth eastern hemlock. *Mountaineer Undergraduate Research Review*, *6*(1), 6-13.

Crime and Community Dynamics in Rural West Virginia Communities

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There is a tendency for sociologists and criminologists to study crime in urban contexts rather than rural. Theories of urban crime do not necessarily fit these rural areas. For example, collective efficacy in urban neighborhoods has been found to be inversely related to crime and fear of crime. In rural areas, this connection has been difficult to study because neighborhoods are more difficult to define. In this study, we expand the notions of collective efficacy in neighborhoods by introducing community dynamics which are latent psychodynamic processes that relate to expectations residents have of each other and of the police. These psychodynamic processes include levels of interdependence, conflict, and dependence. Using a social media survey method from residents in rural West Virginia, we found that high levels of interdependence lead to an increase in quality of life and decreases in risk and fear of crime, while conflict leads to a decrease in quality of life and an increase in risk and fear of crime.

Introduction

The US Census defines urban areas as densely developed territory that encompass residential, commercial, and other nonresidential areas. Rural areas encompass all population, housing, and territory not included in an urban area[1]. These definitions are self-identified by the respondents in our survey. Most criminological theories focus exclusively on urban neighborhoods; however, this is a problem for criminologists who are interested in understanding the nature of crime in rural areas. Rural areas are different from urban centers in several ways, including geographic isolation, availability of guns, economic factors, race and ethnicity, and social climate[2]. These differences make the study of rural crime in its own right a necessity.

Rural areas are located on the outer parts of cities or towns, which leaves them secluded and relaxed compared to the fast-paced and densely populated urban lifestyle. Furthermore, residents in rural areas often possess more guns than people in urban areas. In addition, rural economies are often characterized by chronic poverty, wide-ranging inequality, and single-industry work opportunities[2]. Rural areas also lack the racial and ethnic diversity of urban areas. Finally, due to the fact that many individuals in rural areas know each other, rural communities often rely on informal mechanisms of social control compared to urban areas who typically stick to formal mechanisms—i.e., the police[2].

In this paper, we examine how the dynamic processes in rural West Virginia residences affect the risk of being the victim of a crime and the chance that residents will be fearful of crime.

Literature Review

As a starting point in our study of the rural community context and crime, we draw from the work of Sampson and Raudenbush (1999) to help us define and operationalize the concept of collective efficacy. When the goal is a collective goal, then collective efficacy beliefs form[3]. They may be high or low[4]. In this paper, collective efficacy refers to a neighborhood or community's ability to prevent crime using informal controls, i.e., residents watching out for each other. Formal controls generally refer to the police. Sampson et al. (1997) apply collective efficacy to crime by arguing that places with low levels of collective efficacy will likely experience high levels of crime and

disorder[5]. However, there are two main problems with this application. The first problem relates to the environment. City neighborhoods put people in close proximity to each other. One might expect that people in city neighborhoods are placed closer together compared to rural neighborhoods. Face to face contact regularly helps collective efficacy develop. Collective efficacy was defined by Sampson et al (1999) sociologists as 'cohesion among residents combined with shared expectations for social control in public space'[3]. Studies over time in diverse places such as Chicago, Miami-Dade, and Stockholm, Sweden, have found that among neighborhoods with similar characteristics those with higher levels of collective efficacy had significantly lower rates of crime[3, 6, 7].

Agency & Efficacy

Our work follows Bandura who established that there are three main types of human agency: collective, proxy, and personal[4]. Human agency denotes that individuals working along or collectively can adapt to or transform their circumstances. Collective agency means individuals acting in concert with others. Proxy agency means getting someone to act on your behalf. Personal agency refers to the individual's own initiative to implement successful change. With regard to neighborhood policing and crime, Nolan and Hinkle help us see that the type of agency expected is what launches the psychodynamic processes in local places that affect the community atmosphere and its effect on crime[8]. It starts this way: Either [residents] believe the police are primarily responsible for crime control in the neighborhood (proxy agency), or that they (residents) are co-responsible for creating safe conditions in the community (collective agency). The psychodynamic processes relate the expectations the police and community have of each other and whether they live up to them. When the expectation is collective agency (everyone is involved in public safety), and the residents conform to these expectations, an atmosphere of "interdependence" is created. If residents expect the police (as proxy agents) to protect the community and they are satisfied with the services they provide, and atmosphere of "dependence" appears. In areas where residents expect collective or proxy agency, and the residents or the police fail to meet the standards expected, an atmosphere of frustration or conflict emerge. These three components of a community's atmosphere (interdependence, frustration/conflict, dependence) appear in all places (urban and rural), but in varying levels. For example, if you think of a community metaphorically as a receptacle containing 100% of "atmosphere," its component parts might be 75% interdependence and 20% frustration and conflict and 10% dependence. Viewed in this way, Nolan & Hinkle contend that the contents of the community container are what predict the risk of crime and the odds that residents will be fearful of crime[8]. We test these ideas in the current study as described in the methods section of this paper.

Methods

Participants & Procedures

In the summer of 2017, an online questionnaire was circulated on Facebook via a snowball sampling method. An advertisement for this online survey was posted on the research team's and Research Center on Violence's Facebook pages. Friends were asked to complete the survey and to share the post when they completed the questionnaire. Some researchers have used this method to research subpopulations or difficult to reach populations in a rapid and cost-effective way[9].

This questionnaire yielded a total of 1,431 completed surveys. Participants of this survey were individuals who indicated that they were 18 years or older and currently a West Virginia resident. Qualtrics was used to administer the questionnaire. For this study, we are interested in people who indicated that they were currently living in a rural area or on the outskirts of a city or town. The respondents

were asked, "Which of the following best describes the place where you live?" They were given the following answer choices: a) city or town b) outskirts of city or town c) rural and d) other. Of the 1,431 individuals that completed the survey, 832 (~ 60%) indicated that they were currently living in a rural area or on the outskirts of a city or town.

Measures

Measures of community dynamics were developed according to research by Nolan, Conti, and McDevitt and Nolan & Hinkle[10, 8]. Respondents were presented with an 18-item instrument that began with the following statement: "Generally speaking, the people in my neighborhood or community…" and ended with a specific scenario which can be seen in Table 1 below.

All questions were measured with a five-point Likert scale, with strongly disagree being one, strongly agree being five, and neutral being in the middle. For analytical purposes, a factor analysis of these 18 questions was conducted, using a Varimax rotation. This analysis resulted in questions loading on three factors that expose the neighborhood atmospheres: interdependence, conflict, and dependence.

Dependent variables

Risk of crime is measured by respondents reporting if they had experienced any of the following crimes in the previous twelve months: a break-in, outside theft, robbery, physical assault, motor vehicle theft, assault with a weapon, or verbal or physical hate crime. A risk of crime variable was created to reflect a score of zero if they had not experienced any of the crimes and a score of one if they had experienced at least one of them.

Fear of crime is captured by asking respondents to describe their level of concern about the subsequent events happening to them in their community: having your home broken into; vandalism to your home or car; being mugged/robbed; being physically

Generally speaking, the residents in my community…	Interdependence Factor	Frustration/Conflict	Dependence
…know how to work together to prevent crime	0.692	-0.231	0.135
…don't get along with one another	-0.617	0.304	0.116
… know how to deal with minor community problems	0.697	-0.224	0.021
… are willing to help one another	0.782	-0.174	0.052
… watch out for each other's property	0.798	-0.099	0.101
… tell each other what is going on	0.776	0.018	0.107
…do not work well together on community problems	-0.67	0.261	0.088
…trust each other	0.776	-0.227	0.024
… rely heavily on each other	0.747	0.004	0.179
… are frustrated with the police	-0.207	0.827	-0.113
… call the police for most community problems	0.132	-0.012	0.699
… think the police don't seem to care	-0.232	0.866	-0.132
… think the police do very little to prevent crime	-0.207	0.846	-0.205
… trust the police to be highly effective crime fighters	0.196	-0.693	0.434
… assume the police know what is going on	0.14	-0.338	0.516
… rely heavily on the police to deal with all kinds of neighborhood problems	-0.022	-0.179	0.827
… think the local police are ineffective	-0.215	0.831	-0.24
…have confidence that the police alone are capable of preventing crime	-0.052	-0.272	0.509

Table 1: Factor Analysis of Community Dynamics Variables
*Three factors with eigenvalues over 1 meaning higher than average, **KMO test of sampling adequacy .916 which is a very high sampling adequacy. These are accepted standards in factor analysis research.

	0 = not worried about crime and not a crime victim in the past 12 months.	1 = reported being worried or having been a victim in the previous 12 months.	N
Fear of Crime	50.48%	49.52%	830
Crime	79.78%	20.22%	831

Table 2: Non-urban and Dependent Variable Percentages

attacked because of your skin color, ethnic origin, or religion; being sexually assaulted by strangers; being physically attacked by strangers; being physically attacked by someone you know; and being sexually assaulted by someone you know. The answer choices were not at all worried; not very worried; fairly worried; and very worried. Individually, these were first dichotomized as "not at all worried" or "not very worried" = 0 and "fairly worried" or "very worried" = 1. These dichotomous variables are then used to produce an "overall fear" item where 0 = "not worried about any of the 8 items" and 1 = "worried about at least 1 of the items".

Analysis

In order to examine the effects of community dynamics with crime and fear of crime we employed binomial logistic regression. The results are presented in Table 3 and 4. The results show that the risk of crime is significantly related to community dynamics. More specifically, it is lower when interdependence increases, and significantly higher as conflict increases. We did not detect any evidence of dependence influencing risk in either direction. As interdependence increases by one standard deviation, risk of crime decreases by 32% ($p<.01$). As conflict increases by one standard deviation, risk of crime increases by 61% ($p<.01$). Dependence was not found to be statistically significant in relation to risk of crime.

The results in Table 4 show that the fear of crime is significantly related to community dynamics. More specifically, it is lower when interdependence increases, significantly higher as conflict increases, and it is not affected by dependence when controlling for the other dimensions of community dynamics. As interdependence increases by one standard deviation, fear of crime decreases by 47% ($p<.01$). As conflict increases by one standard deviation, fear of crime increases by 76% ($p<.01$). Dependence was not found to be statistically significant in relation to fear of crime.

Discussion

The primary purpose of this paper was to study the effect of community dynamics on the risk of crime and the fear of crime in nonurban settings. Data for this study was collected as part of a larger state-wide survey, but the findings presented here relate only to those respondents who indicated either that they were living on the outskirts of a city or town or living in a rural area.

In both models, interdependence is associated with favorable odds. That is, increases in interdependence are associated with increases in quality of life, and decreases in risk and fear of crime. Interdependence is statistically ($p<.01$) and practically significant in these models. These findings suggest that

	B	Odds Ratio
Interdependence	-0.38	.68 **
Conflict	.48	1.61 **
Dependence	-0.10	.90

Table 3: Relationship Between Community Dynamics and the Risk of Crime in Rural Areas
* indicates significance at the $p<.05$ level, ** indicates significance at the $p<.01$ level

	B	Odds Ratio
Interdependence	-0.63	.53 **
Conflict	0.57	1.76 **
Dependence	0.02	1.02

Table 4: The Relationship Between Community Dynamics and Fear of Crime in Rural Areas.
* indicates significance at the p<.05 level, ** indicates significance at the p<.01 level

interdependent places are by far the safest, even in nonurban areas.

Conversely, increases in conflict are associated with decreases in quality of life and increases in risk and fear of crime. These, too, are statistically (p<.01) and practically significant. These findings suggest that conflict neighborhoods are the least safe. Lastly, dependence was not found to be statistically significant in these models. Due to there being zero significance, we cannot say if dependence increases or decreases risk of crime or fear of crime.

Conclusion

This paper has discussed three elements of a community atmosphere that result for psychodynamic processes: interdependence, conflict and dependence. The levels of each are related to the risk of crime and fear of crime in rural areas and areas outside of town. Our study shows that places with high levels of interdependence are likely to be the safest. In places where there is a lot of conflict among residents or between the police and community, the risk of crime and fear of crime increase significantly. No statistically significant relationship was found between dependence and crime or fear of crime.

In each neighborhood there is some level of interdependence, frustration and conflict, and dependence. These levels are produced by relationships among residents and between residents and the police. We believe that the police can help foster high levels of interdependence in the way they approach crime and crime control. This may be a difficult concept for individuals in rural areas to comprehend, as rural communities often do not share their internal problems or like to work with the government or law enforcement agencies. However, this is the basis of interdependence. To help address this issue, police must take the steps necessary to form a connection with the community. For example, in Framingham, Massachusetts classes in forensics and hostage negotiation were given to the public to break the "secrecy" that law enforcement agencies often portray. They thought it was a great way to fill in the gaps between the community and the police[11].

The data found is beneficial to many, especially law enforcement agencies, as it is a way to reduce crime for little cost. As stated previously, Weisheit et al. found that many rural economies follow similar patterns, and all of these patterns have ramifications when it comes to policing[2]. Although law enforcement agencies might be understaffed and have limited resources, there is still a way to make a big impact on crime. By using this community dynamics data, police can see that fostering good relationships with their community can directly impact the rate of crime in their area.

Creating these strong relationships among residents and between the community and police takes time but it is certainly achievable and worthwhile.

Acknowledgements

This study was supported by the United States Department of Agriculture (USDA), National Institute of Food and Agriculture (NIFA), McIntire Stennis Project # 1017946, to S. Chhin.

Competing Interests

The author declares no competing interests.

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How to Cite This Article:

Rycek H. V. & Nicewarner R. (2021). Crime and Community Dynamics in Rural West Virginia Communities. Mountaineer Undergraduate Research Review, 6(1).

Faculty Spotlight

Dr. Michelle Richards-Babb

As a first-generation, non-traditional college student majoring in a STEM discipline, I had no idea what I would do with my college degree. I just knew I wanted a career that allowed me to continue learning. During college, a faculty member mentored me in research, which prompted my interest in a research-focused career. That was eye-opening. Fast forward, through graduate school, several teaching positions, tenure and promotion, and finally to my hiring as the Founding Director of WVU's Office of Undergraduate Research and I have come full circle. I am now the one who is helping undergraduates (i) find and engage in research and (ii) reach their full potential. I have the best job!

Undergraduate research is a "high impact" practice according to the Association of American Colleges and Universities (AACU). Peer-reviewed studies provide evidence for its benefits to undergraduates in the form of higher collegiate grade point averages, increased persistence, and improved understanding of graduate school. In 2015, WVU's leadership recognized the value of providing undergraduate research opportunities through its establishment of a centralized Office of Undergraduate Research (UGR). Since then, UGR has grown by leaps and bounds. It now has four full-time staff members who administer its programming with assistance from graduate and undergraduate students. The Mountaineer Undergraduate Research Review (MURR) is UGR's newest and fastest growing signature program. The dream of reviving MURR became a reality in 2020 thanks to a host of motivated undergraduates and a dedicated UGR staff member. What they have accomplished in reviving MURR and the final deliverables (two issues in one year!) is so much more than I ever imagined. I am proud to be associated with such hard working and dedicated students and staff. Mountaineers truly do "Go Beyond!"

Dr. Dana Huebert Lima

Undergraduate research provided my first experience with research as a practice and as a career. I started as a work-study student in a biochemistry lab as a sophomore, because it seemed like a good way to meet my financial needs and academic goals at the same time. That experience was a springboard into my future roles as a research technician learning about stem cell differentiation, to a graduate student understanding molecular responses to physiological stress, and ultimately to my role as a professor at WVU.

Now, as director of the Honors College EXCEL program, I am happy to partner with WVU's Office of Undergraduate Research to provide opportunities and resources for students from diverse academic and socio-cultural backgrounds. The benefits of experiential learning, and research specifically, are vast and applicable to a wide variety of careers. Students learn to ask open-ended questions, receive feedback from academic and community stakeholders, practice cultural awareness, and work in a community of scholars. As a result, they develop transferable skills like adaptability, perseverance, failing gently, and communicating broadly.

The Mountaineer Undergraduate Research Review epitomizes that process, as it was re-developed as a project in the Honors College EXCEL program. The articles here represent the culmination of an enormous amount of work on the part of students, faculty mentors and WVU administrators who create MURR, and the student and faculty authors that completed the research itself. I'm delighted to see the seeds planted by Jeffrey Petty and Teagan Kuzniar, the Editors-in-Chief, come to fruition here.

Association between Stroke Health Literacy and Insurance with Stroke Severity and Post-Stroke Depression

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Health literacy and insurance are important aspects of healthcare, yet few studies assess the roles that each play in relation to strokes. The purpose of this study is to better understand the relationship that stroke health literacy and insurance coverage have on the development of post-stroke outcomes such as post-stroke depression and stroke severity. In this study, 47 patients receiving inpatient care for acute ischemic stroke were given a modified version of the Stroke Knowledge Test in order to assess their understanding of strokes. Stroke severity and depression levels were also measured using the National Institute of Health Stroke Scale (NIHSS) and Hamilton Rating Scale for Depression (HAMD-17), respectively. Additionally, patients were asked whether their insurance coverage influenced their decision to seek out healthcare for their acute stroke-like symptoms and whether their insurance coverage would influence their decision to continue taking any medications or treatments that were started due to their strokes. Among the patients screened, there was a trend towards lower stroke health literacy scores indicating a decreased understanding of strokes among patients who stated their insurance coverage would influence one or more of their healthcare decisions. There was also a trend towards increased HAMD-17 scores indicating higher depression levels in patients who answered that their insurance would influence both of these decisions. However, neither of these trends were significant. Through continued research, it is hoped that these trends will shed light on the roles that health literacy and insurance coverage have on post-stroke outcomes and will provide a more holistic understanding of patient decisions regarding healthcare.

Introduction

Strokes are a type of medical condition caused by the disruption of the blood supply to the brain and are one of the leading causes of death worldwide[20]. Studies have shown that every year in the United States, almost 800,000 individuals have a stroke, and that nearly 25% of all strokes are in individuals who have had a previous stroke[18]. Additionally, it has been found that the risk of stroke recurrence is around 30% in stroke survivors[1].

Broadly, strokes can be broken down into two main categories- ischemic and hemorrhagic. Ischemic strokes are characterized by clots resulting in obstructed blood flow, and account for roughly 60-80% of all strokes. However, hemorrhagic strokes also occur when a blood vessel in the brain ruptures, leading to bleeding in the brain, which account for the remaining 20-40%[2].

The widespread prevalence of strokes is a serious concern because this change in blood flow to the brain has been shown to result in a variety of serious physical, communicative and emotional disturbances, which can lead to morbidity and even death. Examples of these outcomes include partial paralysis, headache, problems producing and understanding speech, as well as emotional disturbances[7].

One example of an emotional disturbance following stroke is post-stroke depression, which is a type of depression that manifests in individuals following both ischemic and hemorrhagic strokes. Unfortunately, post-stroke depression develops in between 18-33% of stroke patients and may have serious effects on physical, cognitive, and emotional recovery following stroke[9]. Further, when compounded with the normal stress associated with inpatient treatment of acute health concerns, incidence of post-stroke depression is found to

be significantly higher in acute stroke patients than patients later in recovery[6] . However, despite the prevalence of post-stroke depression and its potentially severe emotional and physical impacts on recovery, it is often underdiagnosed as these emotional disturbances may not be noticed in the busy inpatient setting[8].

As strokes have been associated with these significant physical and emotional outcomes; stroke prevention techniques are an integral part of primary medical care. While strokes have been shown to be associated with multiple non-modifiable risk factors such as age, gender, and genetic background, there also exist a variety of modifiable risk factors that have been shown to play a significant role in stroke incidence. A few of these widely accepted risk factors that are able to be modified with intervention include hypertension, tobacco use, diabetes mellitus, obesity, physical inactivity, high cholesterol, and atrial fibrillation[14] .

Because so many of the risk factors for stroke are able to be modified with intervention, stroke education has become a significant aspect of preventative as well as post-stroke care. While the relationship between controlling risk factors and post-stroke outcomes varies based on the condition, some studies have found that controlling for things such as hypertension as well as atrial fibrillation decreases the risk of recurring stroke by nearly 50%[21]. However, despite the importance of stroke education, one study found that nearly one third of patients with recurring stroke or transient ischemic attacks could not name a single risk factor for stroke[13].

While health education is of particular importance across all aspects of healthcare, knowledge of the symptoms of strokes specifically is integral in reducing both the risk of stroke onset as well as effectively treating acute stroke. One reason for this is the medication intravenous tissue plasminogen activatorv (tPA), which is a key component of caring for acute strokes. tPA is a medication that can be used to effectively reverse the effects of an ischemic stroke if given within a short window of stroke onset[12]. Thus, stroke education is paramount in ensuring patients are able to identify symptoms and seek out subsequent treatment in the event of acute stroke. This can be evidenced through one study which found that stroke education programs led to decreased prehospital delay for patients experiencing acute stroke-like symptoms[15]. Additionally, other studies have found that decreased health literacy was associated with increased stroke severity and increased length of stay in the hospital[16]. Despite the clear importance that stroke education has on preventative and post-stroke care, it is impossible to consider without also addressing the role that insurance coverage and access to healthcare play in these decisions and outcomes. In the United States, it is estimated that 8.5% of Americans lack insurance coverage[17] and that the average cost of hospitalization when stroke was a primary or secondary diagnosis was $20,396 ± $23,256[19]. Additionally, with the cost of simple checkups with a primary care physician sometimes over $100, the promotion of stroke education and subsequent treatment of risk factors may be unattainable for many Americans.

Unfortunately, this may have serious outcomes. One study found that uninsured patients with hypertension, high cholesterol, or diabetes mellitus were less likely to take medications prior to stroke, use an ambulance to travel to the hospital, or arrive early after onset of acute stroke-like symptoms. It was also found that these patients were more likely to die of their condition and survivors were less likely to attend in-patient rehab than their insured counterparts[10]. Further, another study based in China found that uninsured individuals less than 65 years of age had an earlier mean age of stroke onset and were three times more likely to die of stroke than insured individuals[3]. Thus, it is clear that stroke education and healthcare access are both integral for understanding stroke prevention and mitigating negative post-stroke outcomes.

While there has been significant research

about stroke health literacy and insurance coverage in general, few studies have assessed their roles in the development of post-stroke outcomes such as stroke severity and post-stroke depression. This project seeks to better understand this relationship in the hopes of developing a more holistic understanding of patients' physical and emotional health following acute strokes.

Methods

This comprehensive cross-sectional study was completed on the inpatient stroke service of WVU Medicine's Ruby Memorial Hospital beginning in April of 2019. Patients on the inpatient stroke service able to verbally respond to questions were identified by the members of the stroke team and were subsequently asked if they would be interested completing the verbal survey.

Here, 47 patients with radiographic evidence of acute ischemic stroke were given a short verbal survey assessing whether their insurance coverage played a role in their decision to seek out healthcare for their acute stroke-like symptoms and whether their insurance coverage would play a role in their decision to continue taking any medications or treatments that were started due to their stroke. Of these 47 patients, 23 were male and ages ranged from 20- 90 with a median age of 65.

Thirty-eight of these patients also agreed to taking a modified version of the previously validated Stroke Knowledge Test as well as six true or false questions to assess their understanding of strokes. Every patient also was screened for depression using the Hamilton Rating Scale for Depression (HAMD-17), which is a survey using a numerical scale to assess severity of depression[4].

Patients with a score of 0-7 were not considered depressed, whereas scores of 8-13 indicated mild depression, scores of 14-18 indicated moderate depression, scores of 19-22 indicated severe depression, and scores greater than or equal to 23 indicated very severe depression.

Additionally, stroke severity was assessed using the National Institute of Health Stroke Scale (NIHSS) with higher scores indicating increased stroke severity (NINDS Know Stroke Campaign - NIH Stroke Scale, 2019). Data was analyzed using T-Test, and hedges' g effect sizes, a variation of Cohen's d that corrects for small sample sizes, were calculated using a standardized mean[5].

Additionally, patients were asked to report the trust they had in the healthcare system on a scale ranging from no trust to complete trust. Institutional Review Board (IRB) approval was obtained due to the nature of the study and all participants verbally consented prior to participation (IRB Protocol Number: 1904517369).

Results

Among patients, the median HAMD-17 score was found to be 7, which generally indicates mild depression, with a range between 0 and 17. Further, the median score on the Stroke Knowledge Test was found to be 61.18% with a range between 27 and 86.36%.

Additionally, 68.09% (n=32) of patients reported that their insurance coverage influenced their decision to either seek out healthcare for acute stroke-like symptoms or their decision to continue taking any medications or treatments that were started due to their strokes. Further, 44.68% (n=21) of patients reported that their insurance would influence both decisions (Figure 1).

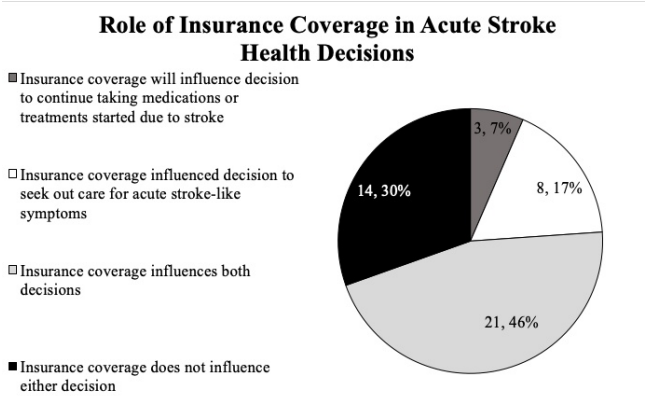

Figure 1: Role of Insurance Coverage in Health Decisions of Acute Stroke Patients

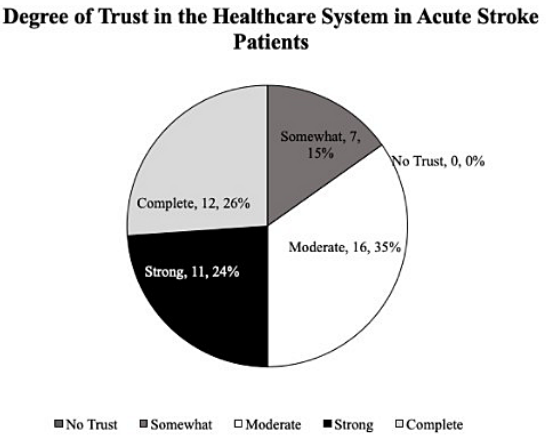

Figure 2: Degree of Trust in the Healthcare System in Acute Stroke Patients.

Of all the patients screened, 37 also consented to completing the modified Stroke Knowledge Test where the median score was 61.18%. Additionally, regarding trust in the healthcare system, no patients reported having no trust in the healthcare system, 7 (15.22%) patients reported somewhat amount of trust, 16 (34.78%) reported a moderate degree of trust, 11 (23.91%) reported strong trust, and 12 (26.09%) reported complete trust (Figure 2). One patient did not wish to answer this question.

There were also a variety of trends in relation to insurance coverage among these patients. For patients who reported that their insurance coverage either influenced their decision to seek out healthcare for their acute stroke-like symptoms or would influence their decision to continue taking medications or treatments that were started due to their strokes, there was a trend towards increased HAMD-17 scores (M=5.67 vs M=8.2, p=0.0552, Hedges' g= 0.52). However, this trend was not statistically significant. Interestingly, there was no relationship between NIHSS and responses to the insurance coverage questionnaire, though there was a trend towards increased NIHSS in patients with HAMD-17 scores that indicated mild depression or higher (M=4.33 vs M=7.1, p=0.08182, Hedges' g= 0.49).

Additionally, the results regarding patient trust in the healthcare system were compared to patients' insurance responses. 41.67% of patients with complete trust in the healthcare system reported their insurance coverage would influence the healthcare decisions highlighted in the methods section. This is contrasted to 72.7%, 87.5%, and 57.15% among those who reported strong, moderate, and somewhat degrees of trust, respectively. There were no evident trends relating trust in the healthcare system with scores on the Stroke Knowledge Test or HAMD-17 scores.

In terms of the stroke health literacy scores, though there was a trend towards increased HAMD-17 scores for patients with literacy scores above the 50th percentile, this trend was not statistically significant (M=6.74 vs M=7.66, p=0.6706, Hedges' g= 0.14). Additionally, there was a trend towards increased NIHSS in patients below the median literacy score, though this trend was also not statistically significant (M=4.29 vs M=6.59, p=0.1361, Hedges' g= 0.38). Finally, though there was a trend towards decreased stroke health literacy scores for patients who reported that their insurance coverage either influenced their decision to seek out healthcare for their acute stroke-like symptoms or would influence their decision to continue taking medications or treatments that were started due to their strokes, this trend was not significant (M=64.03 vs M=58.43, p=0.2856, Hedges' g= 0.38).

Discussion

Though this project did not lead to statistically significant results, it has shed light on interesting trends regarding post-stroke outcomes in relation to stroke health literacy and insurance coverage, which can be used to better understand the reasoning behind patients' healthcare decisions. Further, the findings regarding the general incidence of depressive symptoms among inpatient stroke survivors highlights the importance of integrating mental healthcare in the treatment of acute stroke.

The results of the insurance questionnaire indicate that insurance coverage may be a significant barrier to care for patients with acute ischemic strokes in rural West Virginia,

and are important in understanding patients' decisions to seek out care for acute stroke and to participate in follow-up care. Further, the association between responses to the insurance questionnaire and depression levels highlights the impact that social and environmental factors such as accessible health insurance may have on mental health. However, it was interesting to find that there was no significant relationship between response to the insurance questionnaire and stroke severity or literacy scores. Future data must be collected in order to better understand the true scope of the impact that these trends may have on local health outcomes.

Additionally, the relatively low median score on the Stroke Knowledge Test among inpatient stroke survivors indicates the necessity of increased stroke education in this population. Further, the trend towards lower NIHSS in patients with higher stroke health literacy scores indicates the potential importance of health literacy on stroke severity and leads to questions about the way that stroke education programs may impact such post-stroke outcomes. Future research will need to be completed in order to fully understand this relationship.

Finally, though there were no relationships identified between trust in the healthcare system and insurance coverage, stroke literacy, or post-stroke outcomes, the demographic information regarding patients' trust in the healthcare system overall may serve as a tool to better understand patients holistically. This may provide valuable insight in terms of better understanding patients' interactions with healthcare providers as well as their interactions with the healthcare system as a whole.

Despite the interesting trends that were identified through this research, this study did have various limitations that must be considered when assessing its results. Examples include the cross- sectional nature of this data as well as the relatively small sample size sample size (n=47). Additionally, sampling bias is another limitation of this study, as only patients with acute stroke able to verbally respond to questions were considered. As aphasia is a relatively common side effect of stroke, this decision excluded a population of stroke survivors which may have influenced the data. Further, the decision to only screen inpatient stroke survivors may have influenced HAMD-17 scores due to the prevalence of environmental stressors in the hospital setting as well as the relatively short time between stroke onset and the administration of the survey.

Because this study currently has a limited sample size, it is hoped that with time and an increased sample, the trends that were identified may become significant results. However, though these trends were not statistically significant, many of these findings may still have valuable implications in healthcare, especially in terms of understanding the reasons why patients make the decisions that they do regarding their health. It is hoped that these findings may facilitate the development of a more holistic perspective among healthcare providers regarding both the importance of mental health considerations in the acute care setting as well as the role that insurance coverage may play on patient decision making during acute stroke.

Competing Interests

The author declares no competing interests.

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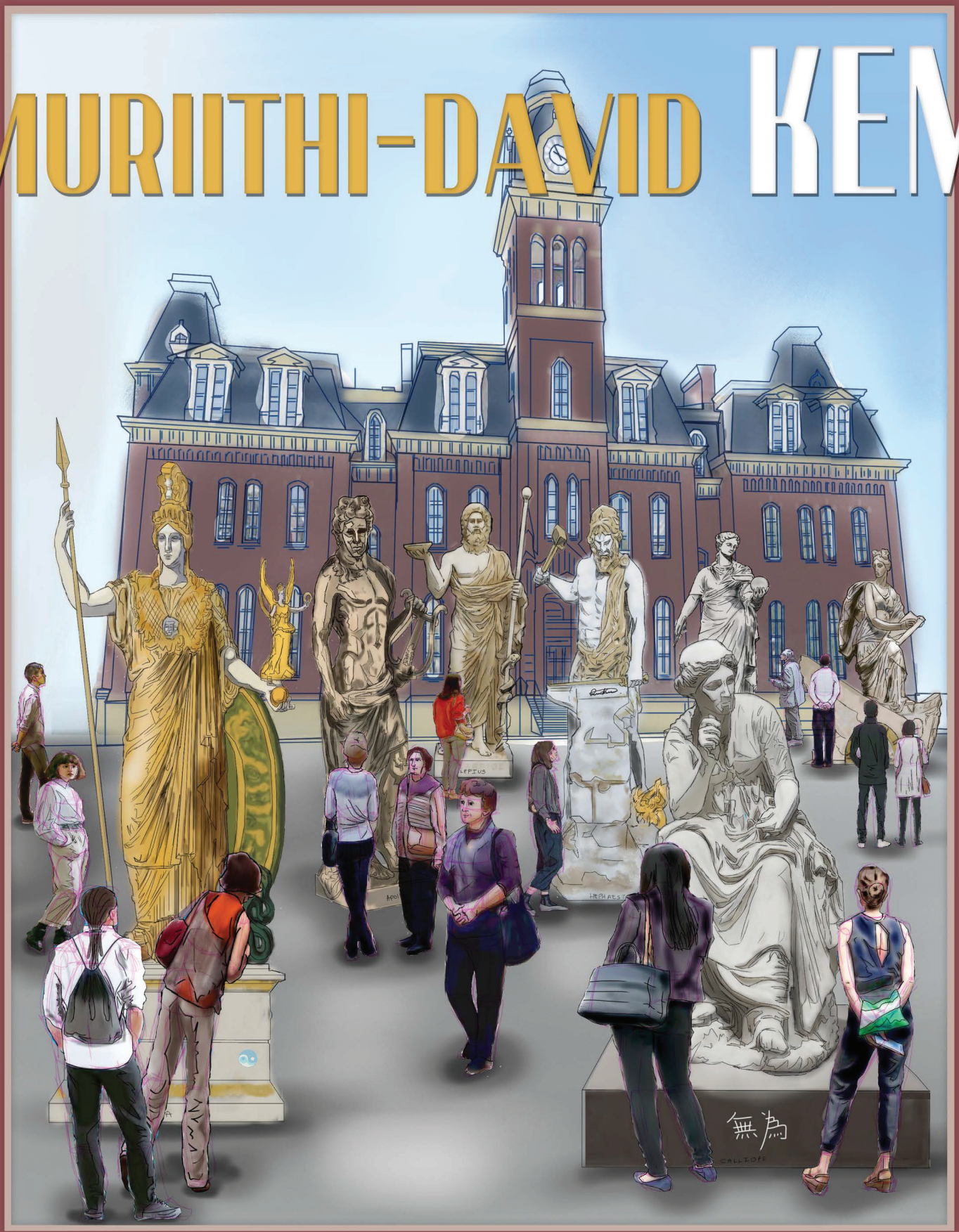
How to Cite This Article:

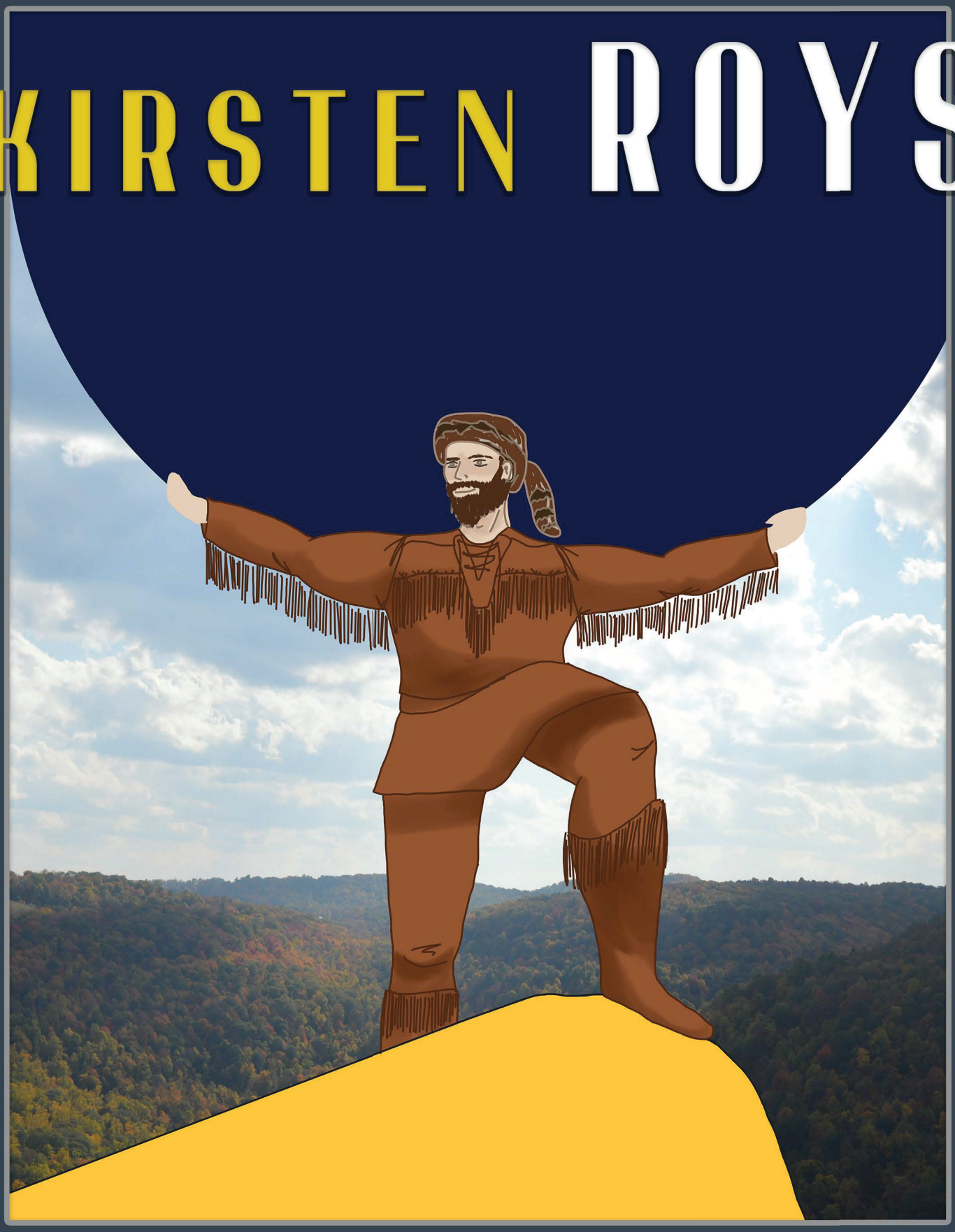
Clairmont, C., Adcock, A., Colantonio, L. (2021). Association between stroke health literacy and insurance with stroke severity and post-stroke depression. *Mountaineer Undergraduate Research Review*, *6*(1), 21-26.

MURIITHI-DAVID KEM



"**Curiosity** *places focus on the sculptures, standing as representations of different aspects within the broader context of research. Calliope symbolizes the work and effort taking place in the arts and literature. Athena symbolizes the mentality of the undergraduate researchers undertaking pursuits that value wisdom and skill. Nike embodies the past, present and future accomplishments of the researchers. This all ties back into the university's commitment to assist in the work conducted by the researchers who aim to make a contribution to their disciplines.*"

KIRSTEN ROYS



"WVU undergraduate research exemplifies the idea of "Mountaineers Go First", and the Mountaineer in my art holds the world for this reason. While drawing the Mountaineer, I thought about the importance of research and how WVU truly makes a difference in moving forward and stepping up when others may not. The time I spent drawing allowed me to reflect on the spirit here and how everything connects - whether it's artwork that seems far from completion or research itself - determination, perseverance (and good company) help us reach new heights and achieve goals we've set for ourselves."

Sex Workers of West Virginia: Contrasting Experiences

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"Sex Workers of West Virginia: Contrasting Experiences" set out to explore the relationship between sex work and identities for sex workers that have worked within the state of West Virginia. The primary goal was to be able to tell a story about why participants began doing sex work and how their economic identities, sexual identities, gender identities, and racial identities have impacted their experiences. While exploring these identities is not uncommon across research involving sex work, previous literature that has shown correlation between identities and likelihood of participating in sex work has only occurred within largely urban areas and research focusing on individuals tended towards victimizing sex workers and predicting their experiences. Instead, through using open-ended questions, this project centers in on individual-level experiences and allows sex workers to tell their own stories which showed that the experiences of sex workers within West Virginia are just as unique as the state itself. Common to participating sex workers within West Virginia is economic-based motivation, recognition of gender, race, and sexuality impacting their work, and strong messages surrounding stigma and empowerment.

Introduction

"Sex Workers of West Virginia" explores the sexual identities, gender identities, economic identities, and experiences of sex workers that have worked within the state of West Virginia and is aimed at sharing the under-told circumstances of this population. Sex work can include any sexual action done in exchange for money or goods. The definition is broad, and inclusive of selling photographs, stripping, camming, escorting, or any other similar job. "Sex Workers of West Virginia" details the experiences of sex workers above the age of 18 that are currently working, or have worked, within the state of West Virginia as it compares to experiences shared within similar literature. Secondarily, it aims to address identities and their impacts on experiences within sex work. This is based in previous sex work research that has found sex work being more common, or more impactful, for people of color, women and transgender people, and people of lower socioeconomic status. Rather than equating these factors to sex work or excluding sex workers that do not fit within these categories, this project fits into the conversation surrounding sex work as a piece that considers these structural differences but prioritizes individuals.

Sex work is not a new topic, and neither are the identities being explored. Despite this, to date, no comprehensive report on sex workers within the state of West Virginia has been completed. This is unsurprising, given that most studies have been located in metropolitan areas with higher populations like London, England, UK[1], New York City, New York[2] and San Francisco, California[3, 4, 5]. However, the identities and institutions that were found to be impacting sex workers within all of these areas are not exclusive to densely populated cities. Previous literature centers around LGBTQIA+ communities, people of color, those with histories of drug use, and lower income individuals being more likely to participate in sex work. All of these identities exist within West Virginia, as does sex work—but there is no research supporting or disproving the correlation between any or all of these factors and participation in sex work within the state of West Virginia.

The singular recent study found that referenced both West Virginia and sex work was a study centered around drug injection and the correlation of drug use and transactional sex. Of the participants within this study, less than 20% of respondents reported engaging in transactional sex. Of those that reported engaging in transactional sex work, those that were also in rural areas were more likely to be female, a sexual minority, houseless, single, and were more likely to experience food insecurity compared to those not in rural areas of West Virginia. Overall, transactional sex was more likely within respondents of this study if they also identified as female, are a sexual minority, are single, experienced an increase in drug use within the past six months, and a few other indicators seem to have some correlation to transactional sex[6].

In terms of impacts surrounding gender identities and sexual identities, research has been varied though these topics appear in some way in nearly all literature on sex work. In a study of sex workers in South Africa, men centered their conversations about sex work on financial incentives and expressed that their identity caused them to feel like outliers, as they experience both the stigma surrounding sex work and the stigma that accompanies going against heterosexual norms or norms about masculinity. For transgender women, violence and stigma can be written off due to their identity being seen as outside of norms as well. Despite this, many transgender women also reported engaging in sex work due to it being affirming of their gender[7]. In a study from Vancouver, people reported feeling like sex work was one of the only jobs where participants felt like they could explore their identities and the parts of their identities that are stigmatized, especially for male participants and transgender participants[8]. A study out of San Francisco opened up a conversation with transgender women of color that are also sex workers on their experiences. In many cases, their identities overlapped which led to an increase in policing, violence, stigma, and many other impacts of varying intersections of identities. This study also emphasizes that lack of jobs due to discrimination impacted these communities and individuals in their likelihood to participate in sex work[4]. Out of nearly 5,000 participants in a survey researching participation in survival economies for transgender people, around 10% reported participating in sex work for survival. For people within this study that participate in sex work, they reported greater odds of discrimination than other jobs, like drug dealing. This falls in line with much of the current literature surrounding sex work and being transgender, which seems to conclude that discrimination and stigma will be heightened based on overlapping identities like being low income or other marginalized identities[9].

Rather than assuming many of the same predictions made within previous literature, this project is aimed at further exploring how gender identities, sexual identities, and economic identities impact sex workers over the age of eighteen working within the state of West Virginia, told through their lens. “Sex Workers of West Virginia” is meant to shine a light on issues impacting the lives of sex workers within our state, with the purpose of understanding that population and their lives better. The experiences shared within “Sex Workers of West Virginia” center around questions of why they began doing sex work, how their identities have impacted their experiences, and how sex work has impacted their lives.

Methods

Research has been conducted through semi-structured interviews consisting of 17 brief questions with interviews lasting up to an hour. Participants were given an incentive in the form of a $20 gift card for interviewing. During interviews, only one investigator and the participant were present, and interviews were held online due to the COVID-19 pandemic. Interviews were audio-recorded with the consent of participants. Selection of participants was largely non-randomized with

information surrounding this project being shared mainly on social media and through WVU's college radio station, WWVU-FM, which is centered in Morgantown, WV. Information was shared specifically with West Virginia University-related organizations, through sex work-specific accounts, on personal social media accounts, and participants were encouraged to share information with others following interviews. Despite the seemingly small social media reach, participants from beyond Morgantown, WV and the academic community here are represented but this community is represented best. West Virginia University acknowledgement and IRB approval are on file.

This research is qualitative, and investigators completed human research training before formulating interview questions. Interview questions were meant to be largely conversational and are reflective of the intersectional feminist perspective the authors have used throughout framing this research. Interviews are structured to feel conversational and largely informal. This is intentional and is meant to give participants the opportunity to discuss their experiences as they see fit. This style of interview is consistent with many previous sex work studies, including work from Ham[10] and Burnes, Rojas, Delgado, and Watkins[11]. Central to both of these studies, and to methodological recommendations from Shaver, a sociologist, professor, and researcher of sex work, is the commitment to looking at sex work with sex workers in mind, rather than approaching sex work as an outsider[12]. This project was developed with the individuality of sex workers in mind, with questions beginning simply with asking, "can you describe an average day for you?" The questions that follow aim at allowing participants to give their own storyline, describe their own identities, and express how their stories and identities are intertwined.

Following completion of the interviews, each interview was transcribed by the investigator that was present for the interviews using the audio recordings. No transcription services were used, to be certain that confidentiality would be maintained. Following transcription, each interview was codified to look for themes. The themes present across interviews, which include conversations on gender identity, sexual identity, influences in beginning sex work, race and ethnicity, financial incentives, and feelings of empowerment paired with stigma related to sex work, are explored below.

Results

Eight participants were interviewed, and each respondent was varied in identity, though almost all are white and identified as a member of the LGBTQIA+ community. Most also primarily worked virtually, though it was mentioned throughout that COVID-19 impacted work, and those that participated in in-person sex work often included virtual aspects as well. Incentives for beginning and continuing sex work were almost always financial, although many participants also expressed that they felt empowered through sex work. On the other hand, nearly every participant also had concerns surrounding stigma, safety, privacy of their sex work status, and mental strain. Consistent to all interviews was the simultaneous positive feelings related to receiving money and other benefits, paired with negative feelings caused by several of the concerns previously mentioned.

Much of the previous literature surrounding gender identities and sexual identities, while not disproven, did not exactly match what was expressed by participants. Previous literature emphasizes that LGBTQIA+ people, especially transgender people or people with intersecting marginalized identities, may participate in sex work because of discrimination which causes lack of other jobs[9,4]. Instead, every participant had a job outside of sex work or was pursuing higher education. Literature also implies that men can be shielded from stigma because of the public focus being on female sex workers[13]. This, similarly, was not reported by any participant, though male participants within this study also identified as LGBTQIA+ which could change

how their jobs are viewed and the stigma around them. Transgender and/or non-binary participants had mixed feelings about sex work affirming their gender, with them stating that they have occasionally felt empowered, but have also felt fetishized and uncomfortable with interactions at various points. This was represented through discussions about outward appearance being connected to the amount of money made, with one participant stating that if they presented more femininely, they made money easier and another participant noted that, while it made them uncomfortable, they would present however a client liked for the right price.

Age of entry and influences in beginning sex work are also commonly explored within sex work research and this was true here as well. Two out of eight participants had their first experiences with sex work before the age of 18, though their experiences were drastically different with one using sex work as a way to survive and another having one early experience with sex work by chance. A study from Baltimore found that participants were more likely to experience houselessness and food insecurity if they began doing sex work before the age of 18 and 36% of respondents overall began doing sex work to meet their needs, including housing and food[14]. For one of the participants that began doing sex work before the age of 18, similar themes were mentioned but today, they feel drawn to sex work because they feel empowered now that they are able to more freely choose that line of work. For other participants that began after the age of 18, financial insecurity was the main reason for beginning sex work as well with several participants expressing that they seeked sex work opportunities based on finances despite its impacts on mental and physical health. One participant reported that sex work more than quadrupled their income. Sex work, for many, was what kept them financially sound and for others, it served to supplement their income but was still a motivator in beginning or continuing sex work.

Race and ethnicity seemed to impact participants based primarily on experiences with clients, with one participant feeling either fetishized or less wanted based on their identities, depending on the person they were interacting with, and most other participants feeling like they were preferred based on being white. Other participants did not express any feelings on this topic. Some literature found that race impacted age of entry into sex work significantly[15,16], but this was not true of the participants represented here. This could be caused by several things—notably, West Virginia is a predominantly white state, and the sample size is small.

In terms of overlapping identities, one participant expressed that they have witnessed racial discrimination within LGBTQIA+ communities that they said could have impacted people in finding sex work opportunities. Gender identity and sexual identity overlapped for a participant who identities as a lesbian, though they have only done sex work with men because they expressed that it is easier for them to feel in control. For another participant, they felt like an outsider both due to their sex work experiences and their sexual identities which led to shame and criticism from peers. Despite these negative impacts, it was expressed by several participants that their identities allowed them to reach broader audiences based on their sexualities and many ultimately felt empowered within their identities through sex work.

Strong themes present within this sample include finances being the primary incentive for all participants, identifying as white being true 87.5% of participants, and identifying as a member of the LGBTQIA+ community being common to 75% of participants. Themes surrounding empowerment and stigma were also present for all participants, though each had different experiences and different feelings towards sex work. While these themes are present within this sample group, many of them are united by other factors that led them to seeing this research opportunity. Ultimately, while themes are present, it remains true that each sex worker had their own perspective on why they

began doing sex work, how they feel about sex work, and how sex work has interacted with their identities.

Discussion

Like many research projects being conducted during this time, the COVID-19 pandemic has impacted this project. All of the interviews were held during the COVID-19 pandemic, and due to the cross-sectional nature of this project, the feelings and experiences of sex workers during this specific time are highlighted. The COVID-19 pandemic also prevented in person interviews from occurring, physical sharing of posters in the area being researched has not occurred, and the impacts of COVID-19 on sex workers became thematically important within the interviews. COVID-19 has prevented this project from accessing those that may not have access to the internet or to social media and travel being impacted by the pandemic has likely limited the reach of this study. This study is further limited as accessing sex worker populations is already challenging due to mistrust of researchers, concerns surrounding being outed as a sex worker, and the population often being purposely underground[17]. It must be noted that none of the participants had participated in street-based sex work. Likely due to the way that information on this study was shared, which is primarily through social media and through academic outlets, participants within this particular study may have different motivations for doing sex work, different identities, and different experiences.

This study set out to provide an additional platform to sex workers that have worked within the state of West Virginia. That goal remained present throughout the interview process and was something that was mentioned by participants as well, regarding why they decided to participate. While there are differences between what has been experienced by those outside of West Virginia, the eight participants represented here are representative mostly of themselves. The message that most participants shared at the end of the interviews, and throughout, was that sex work is not easy and is not meant to be taken lightly. With this in mind, still, it was also shared that sex work was a fulfilling job in many ways and that breaking down the stigma was important. Uplifting sex workers, standing against the stigmatization of sex work, and fighting for sex work to be viewed simply as work is the recommendation of the authors, which can be done while still being realistic about the situational incentives that can be present in beginning sex work and the negative aspects associated with the job.

Ultimately, the sex workers that are represented within "Sex Workers of West Virginia" are as unique as the state itself. They are tied together through a number of commonalities based on economic motivations and identities which may be connected to geographical location and selection of the sample. Of the experiences shared, it can be concluded that financial benefits are the primary concern within sex work and that identities, regardless of how participants identify, have impacted individual experiences. The broadest conclusion, however, is that sex workers are their own beings with their own stories to tell.

Competing Interests

The author declares no competing interests.

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How to Cite This Article:

Thompson, M.M., Rodriguez, E. (2021). Sex workers of West Virginia: Contrasting experiences *Mountaineer Undergraduate Research Review*, *6*(1), 29-34.

The Impact of Vision Zero Initiatives on Road User Safety in New York City

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Despite modern vehicles, improved transportation infrastructure, and advanced traffic signals, more than 36,000 Americans die from traffic crashes every year[1]. With the goal of reducing traffic fatalities to zero, New York City (NYC) adopted Vision Zero (VZ) initiatives in 2014 and has deployed 23 categories of countermeasures ranging from road improvements to training and community outreach programs[2]. In this research, trend analysis and hypothesis tests were done on NYC traffic fatality data for three main categories of roadway users: motorists, cyclists, and pedestrians, to evaluate the success of the VZ initiatives. It was found that annual fatalities of both motorists and pedestrians declined significantly after the deployment of VZ initiatives, while fatalities of cyclists increased significantly. These findings indicate that current VZ efforts in NYC were not effective in improving cyclist safety. A comparative trend analysis was done on the relationship between summonses issued by New York Police Department (NYPD) and traffic fatalities. It was found that law enforcement was ineffective in improving traffic safety. Additional effective countermeasures should be deployed to reduce the frequency and severity of cyclist-involved crashes. Recommended potential measures include additional bike lanes in dense urban areas, wider bike lanes, and law enforcement focused on bicycle helmet usage.

Introduction

Vision Zero (VZ), a traffic safety project originating in Sweden, has been adopted by cities and states in the United States[3]. VZ places the responsibility for traffic fatalities on inadequate facilities for all users and unsafe roadway designs. This program promotes legislative actions, law enforcement, and innovative roadway improvement solutions to increase roadway safety. The VZ project successfully reduced the number of fatalities caused by road accidents in Sweden by half in 20 years[4]. In 2005, VZ was adopted in Poland, a nation with a high number of traffic fatalities per one-hundred thousand residents. According to a study on the effectiveness of VZ in Poland, traffic fatalities fell by 31% after five years[5]. After years of only battling traffic fatalities as a city with no dedicated program, New York City (NYC) started the VZ program in their battle against unsafe roadways under leadership of Mayor Bill de Blasio in 2014[3]. To be recognized as a VZ community, NYC developed an action plan and created a task force to lead fatality-reducing efforts and evaluate progress[3]. The initiatives deployed in NYC include decreasing speed limits in arterial roads and neighborhood areas, installing speed cameras at school zones, and increased overall traffic enforcements[3]. In addition, roadway improvements (i.e., bike facilities, speed cushions, improved crosswalk facilities) across the city were completed to improve traffic safety.

With over 8 million residents in NYC and another 900 thousand daily commuters[6,7], it is important to evaluate successes and failures of implemented road safety initiatives. The objective of this study is to evaluate the effectiveness of VZ initiatives in reducing traffic fatalities among three groups of road users (i.e., motorists, cyclists, and pedestrians) after initiation of VZ in NYC since 2014.

Methods

Trend Analysis

Motor vehicle crash data collected by NYPD

Year	Vehicle Occupant Fatalities	Cyclist Fatalities	Pedestrian Fatalities
2012	122	18	136
2013	107	11	168
2014	101	19	130
2015	93	14	128
2016	71	18	134
2017	89	20	113
2018	78	10	110
2019	74	24	115
2020	118	27	94
Average (2012 to 2020)	94.8	17.9	125.3

Table 1. NYC Traffic Crash Fatalities (2012-2020)

was used in this study[8,9]. Annual fatalities were calculated for three categories of roadway users: motorists, cyclists, and pedestrians for the years 2012 to 2020. A lack of reported crash data prior to 2012 limited the extent of how far in the past this research could investigate crash statistics. The crash statistics are summarized in Tables 1-3, and by locations within NYC (Figures 1-3). The beginning of the VZ program in NYC (i.e., year 2014) was highlighted in each figure for before and after comparison purposes. These steps were repeated in the case of each NYC borough (i.e., Bronx, Brooklyn, Manhattan, Queens, Staten Island). The yearly fatality frequency as well as average annual fatality levels in NYC are shown in Table 1.

Beyond an investigation into traffic fatality levels, analysis was also done on summonses (i.e., traffic violation tickets issued by law enforcement). Summonses were issued for speeding, failure to yield right-of-way, cell-phone usage, and missing driving requirements (expired/no license, no car insurance, or no registration). Data was compiled from NYPD's annual summonses data issued by specific summon types[8]. Figure 4 presents the trend graphs, showing how levels of the specific summons types, from 2012 to 2020. To determine the relationship between summonses and fatalities, general yearly trends were studied. For this, NYC open source data[9] was used to determine how many persons were fatally injured by contributing factors (i.e., cell phone usage, driver inexperience, failure to yield right-of-way). These factors can be categorized as those which the summonses investigated in this research aim to prevent. The fatalities for each year were depicted as a line with summonses levels as bar graphs (Figure 5) to show relative trends over time. Trend lines for both summonses and fatalities were then included. Table 2 shows the data used in comparison of summonses issued and fatality levels.

Hypothesis Test

In addition to trend analysis, hypothesis tests were performed to identify whether the average fatality levels, and average law enforcement levels (i.e., summonses) before and after VZ were significantly different or not. Hypothesis testing is a procedure in which data is used to decide which of two hypotheses is more likely to be true. The steps to be followed to perform a hypothesis test are: 1) state null hypothesis, H_0, 2) state alternate hypothesis, H_A, 3) decide on significance level (alpha), 4) calculate appropriate test statistics, 5) find the p-value of the test statistics, and 6) make decision and state conclusion. For this study, the null and alternate hypothesis were set as follows:

Year	Total Summonses	Summonses for Failing to Yield Right-of-Way	Pedestrian and Cyclist Deaths	Summonses for Uninspected/ Uninsured/ Unlicensed/ Unregistered	Deaths Caused by Driver Inexperience	Summonses for Speeding	Summonses for Phone Usage	Deaths Caused by Distracted Driving
2012	1020754	11698	N/A	131471	N/A	71305	141816	N/A
2013	1036942	14888	17	135205	0	83202	126422	15
2014	1062504	33577	20	122842	6	117767	106503	23
2015	1003043	39853	14	98155	5	134438	84630	38
2016	1042703	42385	28	99916	1	137260	75900	29
2017	1059256	51763	15	88679	7	149955	72276	48
2018	1066376	54477	26	83053	3	152368	49161	22
2019	985057	81615	26	74508	3	148776	37237	38
2020	510342	35257	10	49879	9	125011	15401	28

Table 2. Dataset for comparing summonses and fatalities

Fatality Type	Minimum	Median	Maximum	Mean	Standard Deviation	Coefficient of Variation
Pedestrians	94 (2020)	128	168 (2013)	125.3	19.760	16.72
Cyclists	10 (2018)	18	27 (2020)	17.9	5.280	31.30
Motorists	71 (2016)	93	122 (2012)	94.8	17.586	19.68

Table 3. Descriptive statistics for traffic fatalities in New York City

H_0: The mean fatality/summonses level before VZ is μ_0

H_{A1}: The mean fatality/summonses level after VZ, $\mu_1 > \mu_0$

H_{A2}: The mean fatality/summonses level before VZ, $\mu_1 < \mu_0$

H_{A1} was assumed when the average fatality or summonses increased after VZ and H_{A2} was assumed when average fatality decreased. The significance level was set to 95% (i.e., alpha = 0.05). As the sample size is small (n < 30), t-test was performed instead of z-test. The results of the hypothesis test are presented in Table 5.

Results and Discussion

Descriptive statistics for traffic fatalities in NYC is presented in Table 3. Pedestrians are consistently the most fatally injured group in NYC followed by motorists and cyclists. Despite having the lowest fatality levels, cyclists were the only group with their maximum yearly level after VZ implementation in 2014. This group of fatalities also experienced the largest fluctuation in yearly levels as shown by its coefficient of variation.

Figure 1 shows annual pedestrian fatality levels from 2012 to 2020 in NYC. Overall, annual rates of pedestrian fatalities trended downwards since the implementation of VZ. The fatality levels after VZ were at or below the nine-year average (Figure 1(a)). As Brooklyn, Queens, and Staten Island experienced pedestrian fatality trends that were similar to the citywide trend, their trend graphs are not included in Figure 1. Pedestrian fatalities for Bronx and Manhattan demonstrated a contrasting trend compared to the citywide trend (Figure 1(b), 1(c)) and included in Figure 1. These two boroughs experienced larger fluctuations than the relatively constant decrease observed in entire NYC. Hypothesis

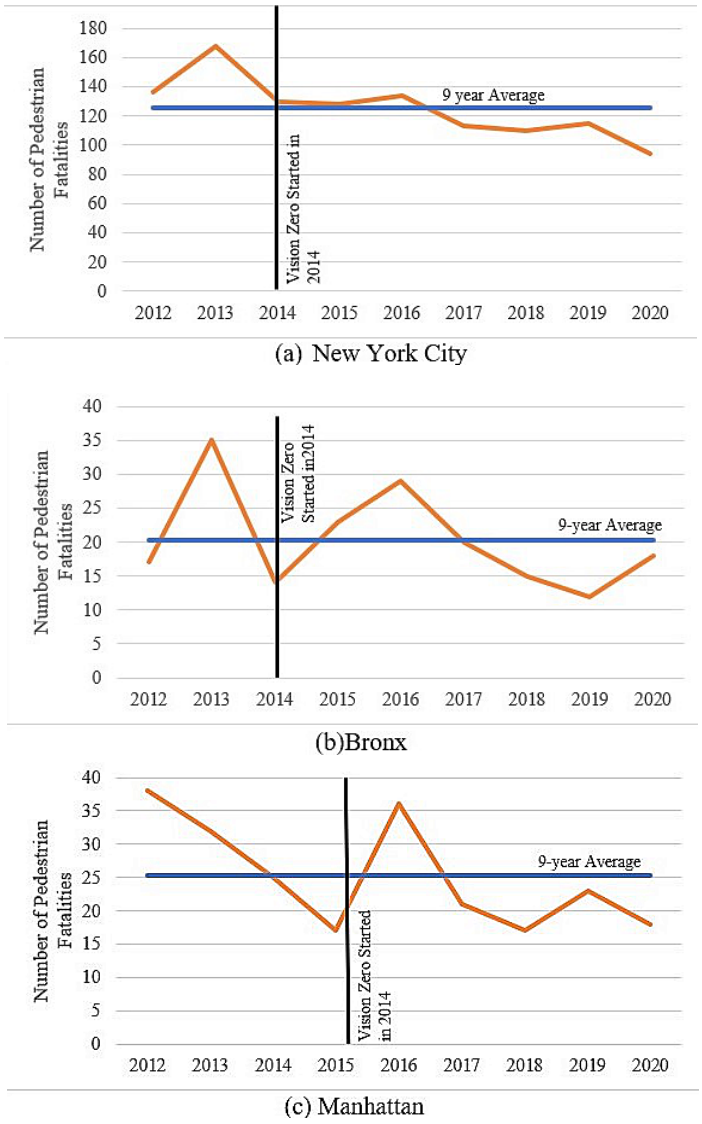

Figure 1. Vision Zero Initiatives' relationship to pedestrian fatalities in NYC and two of its bouroughs

test results in Table 5 confirms that the pedestrian fatality after VZ was significantly lower than before VZ in NYC.

Figure 2 shows annual cyclist fatality levels from 2012 to 2020 in NYC. It is evident that the city experienced a large increase in cyclist fatality from 2018 to 2019 and a further increase from 2019 to 2020 (Figure 2(a)). Hypothesis test results in Table 5 also

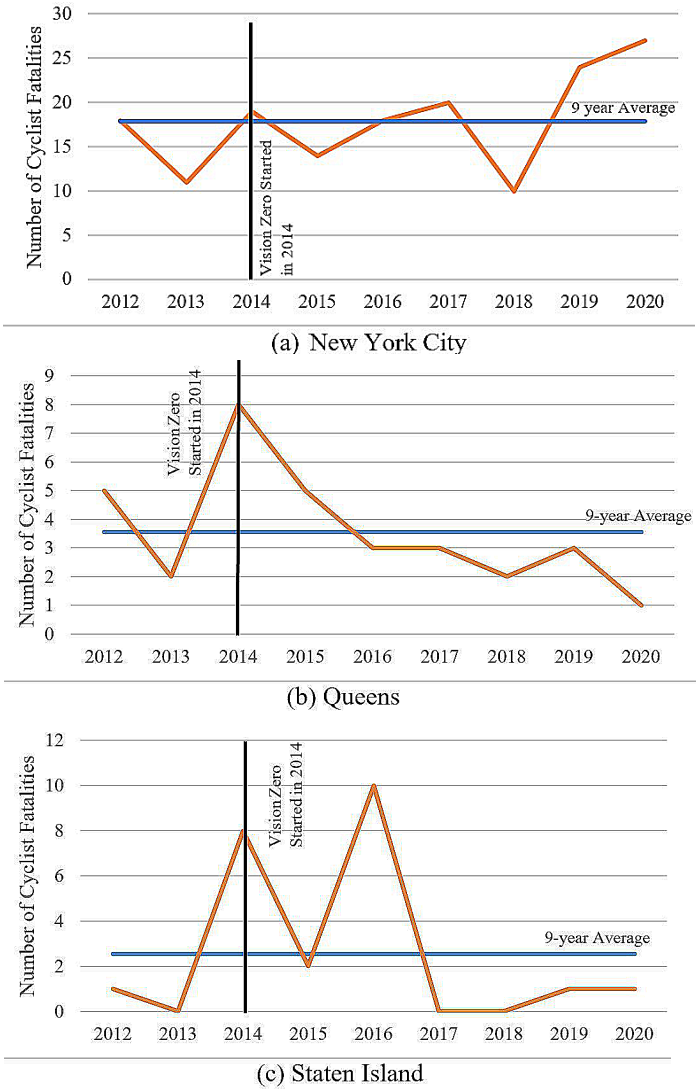

Figure 2. Vision Zero Initiatives' relationship to cyclist fatalities in NYC and two of its boroughs.

confirmed that the cyclist fatality levels after the VZ program increased significantly compared to before VZ. However, Queens experienced a strong decline in cyclist fatalities since 2014 (Figure 2(c)). Staten Island experienced large fluctuations but had very few yearly cyclist fatalities since 2017 (Figure 2(b)). Due to Brooklyn, Bronx, and Manhattan experiencing cyclist fatality trends that mirrored the citywide trend, their trend graphs are not included in Figure 2.

Figure 3 shows annual motorist fatality levels from 2012 to 2020 in NYC. From 2012 to 2019, annual rates of motorist fatalities trended downwards with an increase to pre-VZ levels in 2020. Hypothesis test results in Table 5 showed that the motorist fatality was significantly lower after VZ. The fatality levels after VZ were at or below the nine-year average, with the exception of 2020 (Figure 3(a)). Motorist fatalities in Staten Island and Manhattan increased when the citywide averages were below the nine-year average (2015 in Staten Island, 2017 in Manhattan) and both experienced below average levels in 2020 when the citywide total increased (Figure 3(b)(c)). Due to Brooklyn, Bronx, and Queens

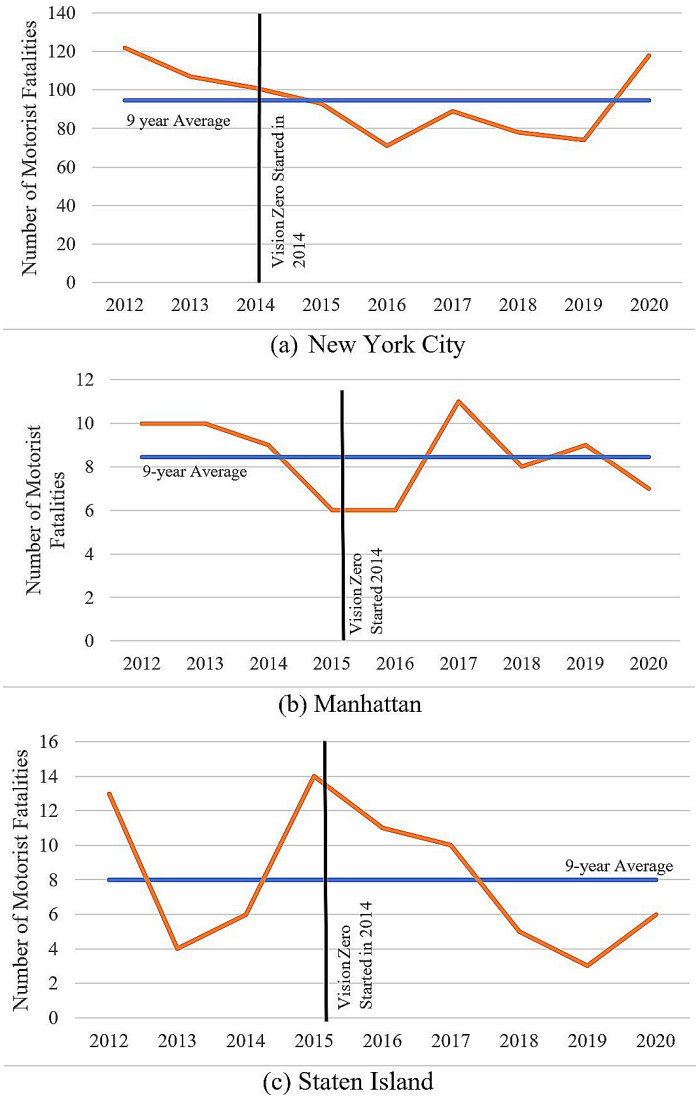

Figure 3. Vision Zero Initiatives' relationship to motorist fatalities in NYC and two of its boroughs

experiencing motorist fatality trends that mirrored the citywide trend, their graphs are not shown in Figure 3.

Figure 4 shows the annual number of summonses issued to drivers for various violations from 2012 to 2020 in NYC. Total annual summonses did not change much since the inception of VZ in 2014 (except in the case

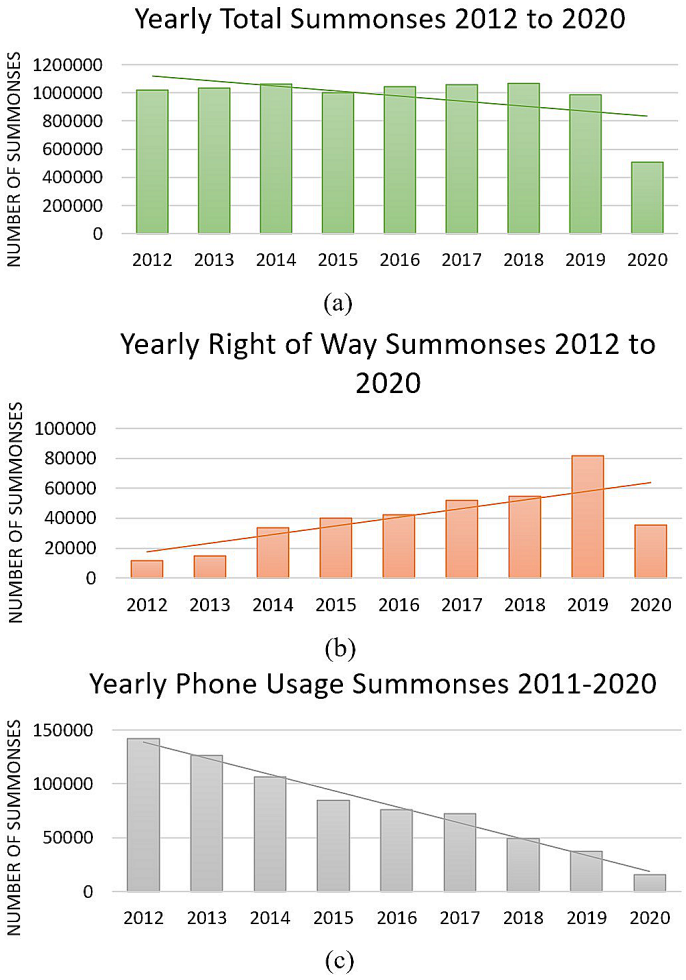

Figure 4. Vizion Zero Initiatives' relationship to traffic law enforcement.

of 2020) which was supported by hypothesis test (Table 5). It could be interpreted that low numbers of summonses in 2020 was due to the Covid-19 pandemic related travel restrictions. In terms of types of summonses (Figure 4, Table 4), failure to yield right-of-way and speeding experienced significant increases over the past nine years while summonses issued for cell-phone usage and missing driving requirements were decreased. Hypothesis test supported significant drop/increase in number of summonses differences before and after VZ (Table 5).

Figure 4 and Table 4 indicate that law enforcement in VZ did not lead to any increase in overall traffic related policing of the streets or quantity of summonses issued, but rather implemented law enforcement that targets violators of especially dangerous driver behaviors, such as speeding and failing to yield right of way. The "precision policing approach" was how NYPD attempted to improve overall safety through law enforcement[10]. Due to this targeted law enforcement practice, total summonses remained relatively stable, while specific types of summons saw significant increases or decreases.

Figure 5 shows the relationships between the number of summonses issued and the number of related fatalities over the period of 2012 to 2020. In the cases of cell-phone usage and missing driving requirements, summons levels declined, and related fatalities saw a relative increase. In the case of pedestrian/cyclist-harm preventing summonses, yearly counts increased but fatalities did not have a consistent change in either positive or negative directions. While this might not reveal causal relationship, this is evidence that VZ law enforcement was not making significant impacts on pedestrian/cyclist safety. One potential reason could be a focus on non-life-threatening traffic infractions rather than more serious violations One example is the documented focus of NYPD on stopping electric bicycle usage which has not been shown to cause fatalities[11].

The average annual pedestrian fatality level has decreased by 13.8% and average annual motorist fatality level has decreased 12.7%, but

Summonses Type	Avg. Before VZ	Avg. After VZ	Percent Change
Total	1028848	961325.9	-6.56%
Right of Way	13293	48418.1	+264.24%
Missing Driving Requirements	133338	88147.4	-33.89%
Speeding	77253.5	137939.3	+78.55%
Phone Usage	134119	63015.4	-53.02%

Table 4. Descriptive statsitics for traffic summonses in NYC.

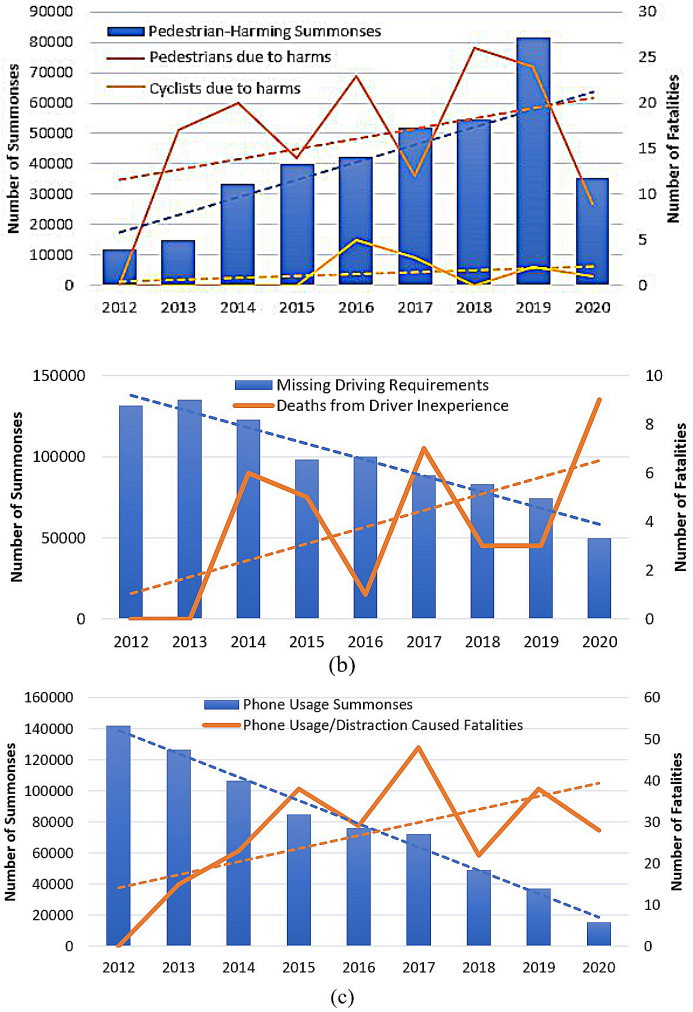

Figure 5. Trend of traffic law enforcement in relation to traffic fatalities in NYC.

cyclist fatalities have increased by 35.7% since the VZ program in 2014. Due to the increase in cyclist fatalities despite VZ countermeasures, this category of traffic safety was investigated further. Cyclist fatalities could increase due to different factors. Despite a number of street improvement projects (SIPs), roadway designs and conditions may continue to be inadequate for overall cyclists' safety. One reason for this may be bike lane obstructions (e.g., trash bags, shopping carts, people, motorcycles, trucks). One study reported 233 bike lane obstructions in Manhattan with an average of 6.6 obstructions per mile[12]. All bike routes studied were protected from roadway traffic- meaning they were on/along the roadway, were designed for cyclist use only and provide physical separation[12].

Obstruction types were divided into three categories: object, pedestrian, and vehicle; and proportion of total obstructions were 53.2%, 28.3%, and 18.5% respectively[12]. The high level of obstructions per mile indicates that despite the availability of protected bike lanes, cyclists still do not have a completely safe way to travel. When obstructions block the intended path of the cyclists, cyclists may divert their routes onto vehicle lanes or pedestrian-oriented facilities posing a danger to themselves and the other road users[13]. Streets with bicycle facilities are far less likely to have cyclist fatalities than those without any bicycle facilities. In NYC, only 11% of total cyclist fatalities occurred on roads with existing cyclist facilities[14].

Another safety concern from inadequate cycling facilities is the risk of dooring. Dooring is where a driver or passenger of a parked car opens their door when a parallel moving cyclist cannot stop in time and runs into the door. The best way to prevent dooring is with increased distance between bike lanes and parking lanes. To keep cyclists outside of the range in which dooring can occur, the bicycle tire must be at least 12 feet from the curb[15]. It was found that bike and parking lanes with 12 feet of width rarely kept cyclists out of traffic and away from possible dooring, but a striped buffer zone between parking and biking could be the more effective solution[15]. Dooring accounts for 12%-27% of urban bicycle-vehicle crashes in NYC[16]. Also, reducing the number of travel lanes while installing bike lanes reduces corridor injuries and fatal crashes by 70%[16].

Another possible factor in increasing cyclist crash fatality could be that more people have chosen to ride their bicycles on the road due to improvement in bicycle facilities. This could lead to higher chances of cyclist crashes because of a higher number of cyclists on the road. From 2014 to 2018, NYC's cyclist population increased by over 660,000 with contributions from campaigns for cleaner transportation and the introduction of Citi Bike's bike share program in the city.

Helmets have been proven to reduce the danger of head impact, the most dangerous injury a cyclist can face. It was found that around 85% of Citi Bike users do not wear

	Fatalities			Summonses				
	Motorist	**Cyclist**	**Pedestrian**	**Right of Way**	**Missing Driving Req.**	**Speeding**	**Phone Usage**	**Total**
μ_0	114.50	14.50	152.00	13293.00	133338.00	77253.50	134119.00	1028848.00
μ_1	89.14	18.86	117.71	48418.14	88147.43	137939.29	63015.43	961325.86
Std dev. After VZ	16.69	5.73	13.98	16599.02	22800.24	13271.41	30913.15	201318.58
H_0: μ_0 =	114.50	14.50	152.00	13293.00	133338.00	77253.50	134119.00	1028848.00
H_A:	$\mu_1 < \mu_0$	$\mu_1 > \mu_0$	$\mu_1 < \mu_0$	$\mu_1 > \mu_0$	$\mu_1 < \mu_0$	$\mu_1 > \mu_0$	$\mu_1 < \mu_0$	$\mu_1 < \mu_0$
α	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Test Stat., t	-4.02	2.01	-6.49	5.60	-5.24	12.10	-6.09	-0.89
p-value	0.003479	.045577	0.000318	0.00069	0.000969	0.00001	0.000446	0.203866
Decision: Reject H_0, if p<=α	p<=α Reject H_0	p<=α Reject H_0	p<=α Reject H_0	p<=α Reject H_0	p<=α Reject H_0	p<=α Reject H_0	p<=α Reject H_0	p > α Can't reject H_0

Table 5. Hypotheses test results for change in fatalaties and summonses after VZ in NYC

helmets[17], and half of all other cyclists do not wear a helmet[18]. While the overall number is better than the observed trends for Citi Bike users, having only half of bike users wearing helmets still shows an unsafe behavior that puts cyclists at a higher risk for serious injury when accidents occur.

To protect cyclists on the streets of NYC and decrease associated fatality, initiatives and roadway redesigns targeted at cyclist safety should be considered. Enforcement to improve helmet usage has the potential to save lives of cyclists involved in head trauma-inducing collisions. Road redesigns that add bike lanes or improve upon existing bike infrastructure should be prioritized. Furthermore, the removal of yielding left turns on green by automobiles should be implemented to prevent cyclist-vehicle crashes caused by failure to yield, as law enforcement did not appear to be effective in reducing this type of crashes.

Conclusions

In this research, open-source data from NYC were used to conduct trend analysis hypothesis tests, and an evaluation of the effectiveness of VZ initiatives in NYC. Average annual fatality levels for both pedestrian and motorist were reduced in the post-VZ years. While this study did not specifically identify what specific VZ actions were helping and to what degree, the combined impact of all initiatives was evaluated. A different trend was observed in the case of cyclist fatalities as fatality levels trended upward compared to motorist and pedestrian fatalities since VZ. This might not reveal a causal relationship between VZ programs and cyclist fatality increases but suggests that VZ programs need to implement more focused initiatives (e.g., bike lanes, helmet usage enforcement) to reduce cyclist fatalities in NYC. Moreover, further research should investigate what factors and safety strategies could improve cyclist safety and develop safe transportation systems for sustainable modes such as bicycles.

Competing Interests

The author declares no competing interests.

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How to Cite This Article:

Phares, A.C., Hossen, A., Dey, K. (2021). The impact of Vision Zero Initiatives on road user safety in New York City. *Mountaineer Undergraduate Research Review*, *6*(1), 35-42.

Depression and Socioeconomic Status in West Virginians

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The purpose of the current study was to determine the relationship between depression and socioeconomic status in West Virginians. A survey was posted to various social media accounts as well as a classroom forum and data was collected from thirty-three individuals who were permanent residents of West Virginia. A variation of the Depression Test gathered from Mental Health America was used in the study with added questions regarding socioeconomic status and descriptive questions, both of which were summed individually and compared using SPSS. Researchers hypothesized that higher depression rates would be associated with lower socioeconomic status. A Pearson correlation analysis revealed that depression and socioeconomic status in West Virginians was negatively correlated. Future researchers can use the current study as a basis for their research in order to determine if there are other factors that could be associated with depression in West Virginians.

Introduction

A significant amount of research has been published regarding the relationship between depression and socioeconomic status in West Virginia. This study was able to find data on depression being a factor of socioeconomic status in West Virginia as well as data on other possible risk factors. Muntaner and Barnett found that forty-two percent of participants who made less than $15,000 annually showed symptoms of depression[2]. In 2017, Gallup and Sharecare found that West Virginia residents reported the lowest levels of well-being out of the fifty states for the ninth year in a row and there seems to be no signs of improvement[3]. When researchers Hendryx and Innes-Wimsatt looked specifically at coal mining to see if there was a correlation, they found that participants that lived near mountaintop removal mining had higher depressive states[4]. This relationship is problematic considering the prevalence of mines, including mountaintop removal mining areas, within West Virginia. Several studies have concluded that low education and marital status (widowed or divorced) played a role in the depressive symptoms and substance abuse displayed in West Virginians [2, 4, 5]. It is important to note that West Virginia is currently in the middle of an opioid epidemic and it currently leads the nation in drug overdoses; 52.8 per 100,000 people overdose in West Virginia and die as a result[6].

Two studies that were examined explained the significance of socioeconomic status on depression. Muntaner and Barnett showed a correlation between those who make less than $15,000 a year[2]. Post et al. found that younger, less educated women (less likely to have good paying jobs) were more likely to be depressed[7]. These studies suggest that when examining factors that cause depression, a lower average salary and lower education levels seem to have a significant effect.

In the current study, the researchers examined the correlation between depression and socioeconomic status in permanent West Virginia residents. How depression is affected by socioeconomic status in West Virginians is an important question to psychologists studying depression in the state, because so little is known about the subject in this specific demographic. Thus, further research is needed. The purpose of the current study was to fill this gap in the literature. A self-report survey created through Survio was used to determine how participants judged their socioeconomic status, and questions were

summed regarding depression rates to determine if the scores were correlated. Researchers for this study hypothesized that lower socioeconomic status would be related to higher depression rates.

Methods

Participants

A convenience sample was taken of 33 people. There were originally 42 participants but 9 were dropped from the study due to not having a permanent residence in West Virginia. Those who qualified participated via an online survey which they accessed from the social media accounts of one of the researchers (Facebook, Twitter, Snapchat, and Google Classroom). The sample consisted of participants who were still in high school or had dropped out (7.1%), participants who graduated high school (11.9%), participants who had attended or completed some college (73.8%), and participants who had graduated college (7.1%). The sample consisted of 11.9% of participants who have a household income of less than $15,000, 19% of participants who make between $16,000 and $29,000, 11.9% of participants who make between $30,000 and $49,000, 9.5% of participants who make between $50,000 and $69,000, 14.3% of participants who make between $70,000 and $89,000, 9.5% of participants who make between $90,000 and 119,999, and 23.8% of participants who make over $120,000. Participants were recruited from friends, family, and classmates who saw the survey on the social media platforms.

Materials

Participants were given a five to ten minute survey (appendix A) assessing West Virginia residency and questions derived from the depression test such as, "I have little interest or pleasure in doing things[1]." Questions related to socioeconomic status were also included, e.g., "What is your annual household income?" Participants with a household income below $49,000 were considered low socioeconomic status, $50,000 to $69,000 were considered the median group, and participants with a household income of over $70,000 were considered high socioeconomic status.

In order to assess depression, questions four through thirteen were coded 0-3: "not at all" being 0, "several days" being 1, "more than half of days" being 2, and "nearly every day" being 3, which allowed for a minimum score of 0 and a maximum score of 30. The last question on household income was coded on a scale of 1-7 in order to determine socioeconomic status: less than $15,000 being 1, $16,000 - $29,000 being 2, $30,000 - $49,000 being 3, $50,000 - $69,000 being 4, $70,000 - $89,000 being 5, $90,000 - $119,999 being 6, and anything over $120,000 being 7.

Design and Procedure

Participants accessed the survey link via one of the four social media platforms it was posted to (Facebook, Twitter, Snapchat, Google Classroom). After following the link, participants were prompted by a screen informing them that the survey would take 5-10 minutes. Participants had the ability to exit the browser and end the study if they desired. After completing the survey, participants were given the national suicide hotline phone number and directions on how to text the suicide hotline if they were feeling depressed. Each participant was given an ID number which had no meaning and could not be traced back to them.

Data Analysis

Data analysis was performed using SPSS software for statistical analysis. A Pearson correlation analysis was conducted with an alpha level of 0.05 to determine the relationship between socioeconomic status and depression.

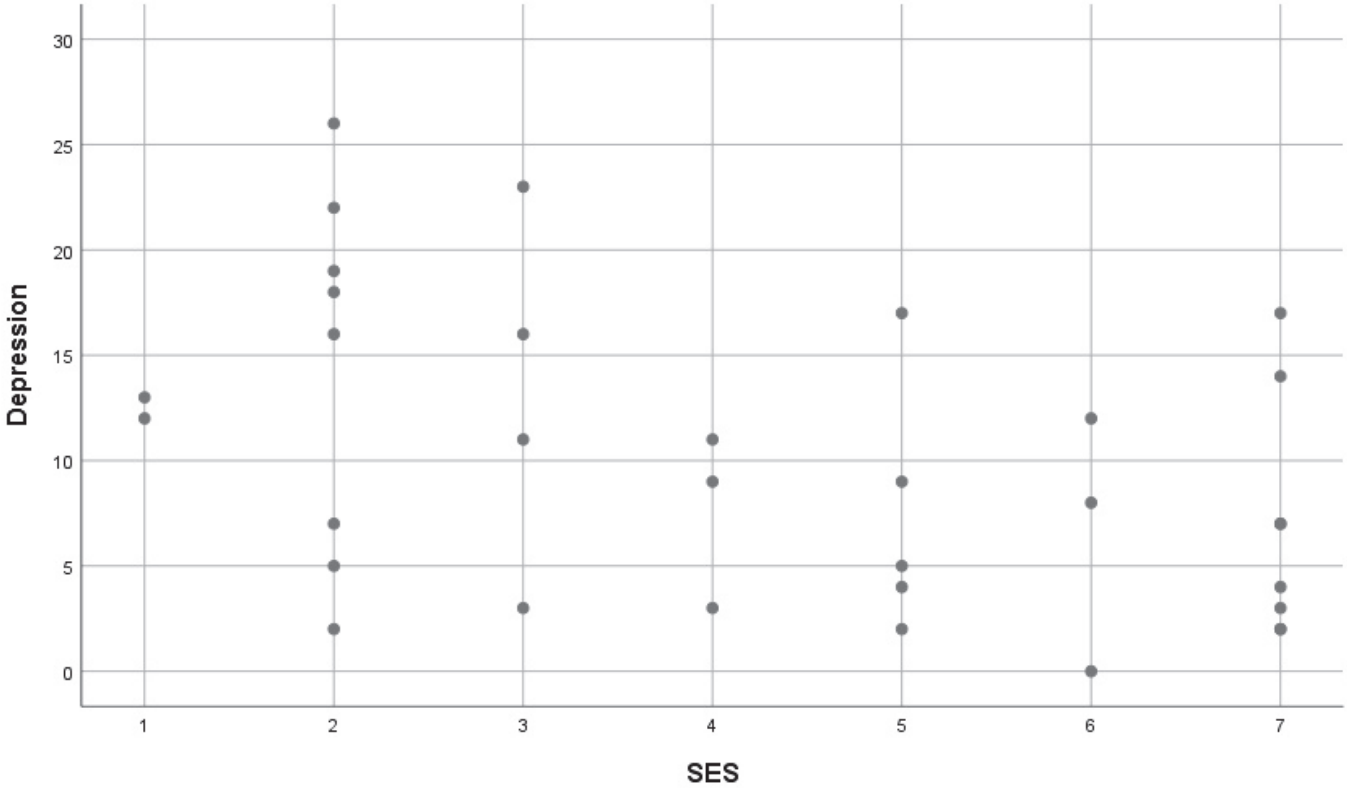

Figure 1. Depression scores as a function of socioeconomic status.

Results

Participants with higher socioeconomic status scores (M = 4.27, SD = 2.096) had much lower depression scores (SD = 7.748) than participants with lower socioeconomic status scores who had higher depression scores (M = 9.97, SD = 7.020). Figure 1 shows the negative correlation between socioeconomic status and depression. The Pearson correlation indicated that participants with lower socioeconomic scores (M = 4.27, SD = 2.096) had higher depression scores (SD = 7.748) and did have significantly lower depression scores than students with higher socioeconomic scores, $r = -0.412$, $p < 0.05$.

Discussion

This study was conducted to assess the relationship between socioeconomic status and depression. Researchers hypothesized that participants with a lower socioeconomic status would have higher depression rates and that those with a higher socioeconomic status would have lower depression rates. After conducting correlation analyses, researchers found that there was in fact a negative correlation between depression and socioeconomic status, supporting the proposed hypothesis. This data found in the current study reiterates what was found in Muntaner and Barnett's work, which found that people who made less than $15,000 a year were 42% more likely to be depressed than those who made more money annually[2].

Limitations

The first limitation researchers encountered was the amount of time given to conduct the study. Most research studies take a half a year or more to collect data in order to come up with a large, testable sample size, while this study had less than a week to collect data. Another limitation was lack of participants, as the study only included 33 people, making it difficult to determine if there is a real correlation or if there is a 'friend group bias' due to the survey only being sent out on social media.

Additionally, participants were not tested in a laboratory setting and could take the survey anywhere. This makes it difficult to know if participants were just submitting answers or if they actually took the survey seriously and answered truthfully. Participants could have been distracted by other people, sounds, cell phones, or anything going on in the space that researchers could have prohibited in the laboratory. Future research should include reverse coded questions in order to know whether or not participants were truthful in their answers.

Researchers are also unsure of whether or not participants lived at home or alone, as this factor could dramatically increase or decrease the number indicated for socioeconomic status.. To fix this problem, researchers could add further details to the question about socioeconomic status, asking if participants live with their parents or not and what their own financial situation is.

Implications

Current and future researchers will be able to use the data collected from the current study to provide more background on depression in West Virginia. Due to the fact that this study was a replication of Muntaner & Barnett's study, both studies could be used as groundwork for anyone wanting to find more information on the topic. By finding a relationship between depression and socioeconomic status, the findings of the current study help give perspective to mental health specialists and researchers in the state. Knowing how socioeconomic status can positively or negatively affect mental health will help clinical psychologists when they are dealing with a client from a lower socioeconomic status.

Future Directions

Future research should devise a more thorough measure to determine socioeconomic status. While asking participants about their household income was a good way to determine socioeconomic status, researchers are unsure if participants with higher socioeconomic status and higher depression scores are contributing their income to that of their parents rather than their own. Research suggests that factors like smoking and education play a role in socioeconomic status; future researchers could incorporate these other factors into their research to find more significant correlations[7].

Acknowledgements

I would like to thank my parents, Lisa and Willis Phillips for never letting me give up and pushing me to submit this paper, my sister for encouraging me in everything I do, my co-researcher Amy Alvarez for helping me develop this research topic, and all of my amazing coworkers that encourage me every day to never give up.

Competing Interests

The author declares no competing interests.

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How to Cite This Article:

Phillips, B.N. & Alvarez, A. (2021). Depression and socioeconomic status in West Virginians. *Mountaineer Undergraduate Research Review*, *6*(1), 43-50.

Appendix A

Depression and SES in West Virginia

Dear Sir / Madam,
Thank you for participating in my survey, please note that you will remain completely anonymous. By filling out this 5-10 minute survey, you will help me obtain information for a research study.

1. Do you have a permanent residence in West Virginia?
   Yes
   No

2. How long have you lived in West Virginia?
   1-5 years
   6-10 years
   11-15 years
   16+ years
   I do not/have never lived in West Virginia

3. Do you feel depressed?
   Yes
   No

4. I have little interest or pleasure in doing things
   Not at all
   Several days
   More than half of days
   Nearly every day

5. I feel down, depressed, or hopeless
   Not at all
   Several days
   More than half of days
   Nearly every day

6. I have trouble falling or staying asleep, or sleeping too much
   Not at all
   Several days
   More than half of days
   Nearly every day

7. I feel tired or have little energy
   Not at all
   Several days
   More than half of days
   Nearly every day

8. I have a poor appetite -- not eating enough or overeating
Not at all
Several days
More than half of days
Nearly every day

9. I feel bad about myself -- or feel that I am a failure or have let myself or family down
Not at all
Several days
More than half of days
Nearly every day

10. I have trouble concentrating on things, such as reading or watching television
Not at all
Several days
More than half of days
Nearly every day

11. I am moving or speaking so slowly that other people could have noticed (or the opposite -- I am so fidgety or restless that other people could have noticed)
Not at all
Several days
More than half of days
Nearly every day

12. I have thoughts that I would be better off dead, or have thought of hurting myself
Not at all
Several days
More than half of days
Nearly every day

13. If you have checked off any problem, how difficult have these problems made it for you at school, work, home, or with other people
Not at all
Several days
More than half of days
Nearly every day

14. What is your highest level of education
Middle school
Some high school
High school
Some college
College
College graduate

15. Do you work
    No
    Casual
    Part time
    Full time

16. Are you a current or former smoker
    No
    Former
    Current

17. What is your annual household income
    <$15,000
    $16,000-$29,000
    $30,000-$49,000
    $50,000-$69,000
    $70,000-$89,000
    $90,000-$119,999
    $120,000 or more

If you're feeling depressed or are in need of someone to talk to, please call 1-800-273-8255 OR text HOME to 741741.

Thank you for participating in my survey.

Student Spotlight

Jeffrey Petty

Throughout my college career, I have had many opportunities to enhance my experience at WVU. I was first introduced to the Office of Undergraduate Research through the Summer Undergraduate Research Experience (SURE) during the summer after my freshman year. During that time, I worked as a full-time researcher in Dr. Teiya Kijimoto's developmental genetics laboratory, and I continued to work in Dr. Kijimoto's lab until my graduation in Summer 2021. My research project for SURE was centered around discovering how unrelated genes help to develop and maintain new traits in species. Specifically, we wanted to know how Hedgehog pathway genes and doublesex, a sex determining gene, are differentially regulated in maintaining horn sizes in Onthophagus taurus beetles. By participating in SURE, not only did I quickly learn many lab techniques and skills, but I was also provided the opportunity to become acquainted with many other undergraduate researchers and their work. It was then that I began to comprehend the important role undergraduates fill in the research community at WVU. This realization led me to apply and participate in the Honors EXCEL program as part of its first cohort of students.

As a student in the Honors EXCEL program, I have been working alongside the Office of Undergraduate Research and other hard-working undergraduates to re-establish Mountaineer Undergraduate Research Review (MURR). MURR is a multidisciplinary undergraduate research journal that accepts research articles from undergraduates for publication consideration. Like many other undergraduate research journals, MURR is published and led by undergraduate students. One of the overarching goals of my EXCEL project is to ensure that MURR is sustainable for future. With new students growing into leadership roles, I am ecstatic to say that we have accomplished our goals for sustainability, and I am excited to see where MURR's new leaders are able to take the journal.

Having been one of the leaders of MURR over the past 2 years has been an invaluable experience, and it has been of great benefit for my overall education. My experience with MURR has played a huge role in the direction of my future as I have accepted an offer to work with Science Advances as a member of their editorial staff. In conjunction with Science, Science Advances is an online open-access journal published by the American Association for the Advancement of Sciences, and it is one of the fastest growing journals in the country. I am very excited to be a part of their rapid publishing process, and I hope to share what I learn about their process with MURR in the future.

Savannah Hays

Growing up in West Virginia within rural Appalachia, a person with a college engineering degree is difficult to stumble upon and it is even more difficult to find a woman with a college engineering degree. As a first-generation female engineering student, I felt a little lost when it came to college preparation. As a rising senior biomedical engineering student at West Virginia University, I serve as the Vice President of the WVU Society of Women Engineers (SWE). I have been involved with WVU SWE since my first year of college and previously served as the secretary. For my Honors EXCEL project, I am developing a Morgantown SWENext Club for female high school students in the area to provide them with resources for college preparation and professional development in engineering careers. After the establishment of the Morgantown SWENext Club, I will expand my outreach to other parts of West Virginia. With this goal, I was selected as WVU's 2021 Newman Civic Fellow as I work to form more SWENext Clubs throughout West Virginia.

Outside of SWE, I have developed a passion for research. Coming into college, I was unaware of undergraduate research and how quickly I could get involved in it. At WVU, I started in the Research Apprenticeship Program (RAP) and also completed the Summer Undergraduate Research Experience (SURE) following my first year of college. During this time, I worked with Dr. Shuo Wang in the Department of Chemical and Biomedical Engineering and the Department of Neuroscience studying facial processing in individuals with autism spectrum disorder. Throughout this time I was able to present poster presentations at various WVU symposiums and also at WV Undergraduate Research Day at the Capitol in 2020. These research experiences have inspired me to continue research into my professional career and become a physician-scientist.

Because of my passion for research and my undergraduate research experience, I joined MURR in 2019 as a STEM editor. My favorite part about this role is reviewing submissions from undergraduate students and learning about the research they are doing. Research is inspiring to me because it is a continuous learning cycle. Reading about the research being conducted by other undergraduate students around campus is astonishing.

I also serve as a tutor for the TestWELL Learning Center at WVU where I tutor in chemistry, mathematics, and engineering. In my free time, I love exploring the outdoors and spending time with my friends snowboarding at Wisp Resort or hiking at Coopers Rock.

Health Care Disparities Around the Globe

Brianna N. Hodak, Renee K. Nicholson
West Virginia University Eberly College of Arts and Sciences

In Honduras, there are only 0.8 physicians for every 1,000 citizens, creating a nearly insurmountable barrier on the ability to access health care for the impoverished lower and middle classes. Various health care models that a country adopts directly affects the quality of life of its citizens, including access to care and clean water, advocacy of preventative methods, and life expectancy. By analyzing models, such as the "Out-of-Pocket", Beveridge, and Bismarck models, one can see that there are positive and negative aspects in every system. It can also be seen that the American Healthcare system is also in dire need of a reform. While Honduras is the main focus, being able to understand how barriers to healthcare arise will be essential in understanding how to bridge the gap of healthcare disparities even in places such as Appalachia. This article discusses disparities within the healthcare system itself, preventative care versus late-stage procedures, and how wellness is linked to socioeconomic status. Emphasis is placed on barriers to healthcare, which is seen in a study that took place in Honduras.

Introduction

In Honduras, there are only 0.8 physicians for every 1,000 citizens, creating a nearly insurmountable barrier on the ability to access health care for the impoverished lower and middle classes[1]. These classes can only access resources that come purely from an underfunded and scarcity-riddled public sector. These barriers to accessing health care can be seen around the world as millions struggle to obtain adequate care. Someone's quality of life can be greatly affected in a negative way because of a lack of resources and care. By becoming informed on these current global conditions and systems countries adopt, one would be more aware of their surroundings and can make informed decisions regarding their own health care system. While choosing a national health care model is out of the individual citizen's control, it is important for lawmakers to realize the effects that a model can have directly on the population. Various health care models that a country adopts directly affects the quality of life of its citizens, including access to care and clean water, advocacy of preventative methods, and life expectancy. In a previously published study, regions of Honduras studied the percentage of people who have access to clean water and specialized procedures, which varied among class to affect quality of life. Further, needs such as clean water and the access to health care are basic human rights that are integral when discussing the ethics of healthcare.

Background

In order to evaluate the effect that health care systems have on quality of life, one needs to understand how exactly the models work. The simplest of the four models is the "Out-Of-Pocket'' model. This system is adopted by India, South America, and regions in Africa. This is not an official system as it does not offer "mass medical care"[2]. This model restricts those who do not have the ability to pay for medical or dental attention, and there is no program in place to help those in need of it to receive care. There is also no insurance to help cover costs, and therefore if someone is in need of care then they would simply have to pay the high costs out of their own pocket with no type of government assistance. The Out-of-Pocket model is a barrier to those living in resource-reduced regions of the world, leaving

many of those who live in these areas unable to see a doctor during their entire lives. When considering how this relates back to Honduras, one can observe that living conditions in this type of system are remarkably similar to the conditions in that country. It is extremely likely for somebody living in the resource-reduced country of Honduras to be able to live an entire lifetime without ever having seen a physician or dentist. In fact, a survey administered by the HOMBRE mobile clinic sites in Coyoles, Lomitas, and La Hicaca states that a percentage of respondents indicated there was more than a three-hour travel time to access a physician[1]. Barriers of distance and transportation in these countries hinder the quality of care one can access.

In comparison to other countries, the system in the United States of America is difficult to categorize as any specific model because of its many intricacies. Essentially, different aspects from each model fit into the American system, most often based upon socio-economic classes. The poor in America who do not have health insurance may experience the Out-of-Pocket model. On the other hand, those who have employee health insurance may be experiencing the Bismarck model similar to Germany. The main features of the Bismarck model are that universal health care is the responsibility of the government, implementation of health policy is through small political units and government officials determine the terms of medical care. Therefore, there is an unequal balance of coverage for its citizens, negatively affecting the quality of life for low to middle income families. While countries that follow the Bismarck model may have easier access to insurance, they also experience rigid government-controlled health care, where some doctors can be considered government employees[2]. The benefit of this is that procedures and medications are rigorously regulated. On the downside, politicians with no medical background should not have the authority to override what a medical professional had deemed the best approach for a patient. A final model, the Beveridge, can be seen in the care given to veterans in the US, where healthcare is provided and financed by the government[2]. By studying a familiar system, it is easier to compare the access and barriers to health care that are experienced to other countries' models that may be unfamiliar. It is interesting to note not only the differences but also the similarities between barriers to healthcare in both resource-reduced regions of the world, such as Honduras, and impoverished areas in the United States, such as Appalachia.

While in America we have access to clean water, pharmacies, etc., the Out-of-Pocket model inherently puts the lower class at a disadvantage and government employed doctors risks the integrity of health care by allowing health care decisions to be overseen by politicians. This shows that while a developed nations system may be seen in a more positive light by the public than a developing nation, there are still innate ethical issues that create a disparity based on economic class that needs addressed. While considering the American system of healthcare, there is unsurprisingly controversy surrounding the quality of care given to patients because of high expenditures. After some research one can see that America may not be up to par to certain prespecified standards set forth by the World Health Organization. In fact, there are many that criticize the American system for having the highest expenditures while only ranking 37th on the World Health Organization's list in terms of quality of care[3]. One of the issues that critics note within the American system is that it focuses on what is known as "late-stage procedures" instead of preventative care. France, who ranks number one on the WHO list, has a system that focuses more on preventative measures and advocates healthy wellness. These differences can also be seen when comparing America and Japan. For example, the United States spends about $7,400 per person per year on health care, even though on average Americans see the doctor about five times per year. Japan, on the other hand, spends about $3,400 per person and the

citizens on average see a doctor fourteen times a year[3]. Some suggest that the American health system can cut their almost double than average costs while still improving conditions if the focus shifts to similar preventative techniques[4]. One theory why preventative care is not a priority in America is that insurance companies do not want to spend money on diagnostic tests and other screenings. It is counter-intuitive to spend more on late-stage procedures rather than to receive early testing. However, the benefit of immediate savings to the insurance companies encourages this type of thinking that results in harm to the individual customers. Instead of focusing on health and ethical decisions, this can almost be seen as a business decision. Not only can this train of thought increase the financial burden of medical expenses, but it also can have a negative impact on an individual's health. This "hold" that insurance has over citizens can increase the likelihood of a patient dying if cancers and other conditions are not caught early enough.

Similarly, there are multiple articles describing methods of reform that can be utilized to improve the quality of life among a multitude of countries. In the Journal of Public Health, Han argues that those living in disadvantaged countries are in a medical poverty trap because there is a financial barrier to access health care services and are at financial risk due to easily contracted illnesses. According to a World Health Organization definition of health care systems, the model should work towards "improving the health of the populations they serve, responding to people's expectations, and providing financial protection against costs due to illness" . Han also describes some health care reforms that are being adopted by various countries, in order to improve access. China and Zambia are trying to reform their health care system for low to middle income brackets by providing universal health care to all of its citizens. Vietnam, Mexico, and China again are trying to reform the system by also providing health insurance for the poor who may not previously have had insurance. Mexico's insurance reform was deemed successful based on its implementation of allowing "free access to an explicit set of health care services" at the time of the procedure. However, one shortcoming of these strategies is that health care providers develop a demand inducing behavior if the patient's care is being covered by universal health care . Over time, a demand inducing healthcare approach can develop into the paradigm of the physician/patient relationship, where physicians recommend treatments whose costs actually outweigh any possible medical benefits. In other words, it is hypothesized that some physicians use their power to influence their patients to make particular choices, thus creating their own demand. While this has the ability to alter delicate market demand, the main detractor of demand-inducing behavior is that physicians violate the oath of duty and make decisions based on lining their own pockets instead of what is in the patient's best interest. Since the 1970s, one study's research focuses on the disparities of health care models within the system itself. This means that the researchers are actually medical students who shadow, work, or intern in various medical facilities around the world, and are able to assess the barriers keeping patients from receiving care as well as the limitations they may encounter as health care providers in different countries. Currently, John Hopkins university in the US and Emory University in the UK are involved with this study, with efforts to expand it to other countries .

By evaluating the Honduran system, one can see further separations between a public and private sector, serving different socio-economic classes unequally. The public sector consists of the Ministry of Health and Social Security, while the private sector consists of "for-profit and non-profit institutions," meaning that the private sector is funded by financially well-to-do institutions or big businesses, while the public sector, which is what the majority of the citizens find themselves participating in, uses funds provided from the government and appropriated to help a large population of

people . The private sector only accounts for the wealthiest 10% of the population in Honduras . Therefore, the lower and middle classes are already at a disadvantage compared to the extreme upper class. It is important to note that the majority of the population are the lower and middle classes, and they receive less resources and less quality care than the wealthy ten percent. By developing the system into two sectors, the Honduras government inadvertently automatically puts most of its citizens at a disadvantage because access is differentiated between those of different class status. Most of the medical facilities are located in the large cities and easily accessed by only the wealthiest in the nation . The wealthy are able to obtain the most resources and a higher quality care than the lower classes. Those living in the most destitute areas of Honduras struggle to obtain clean water supplies, sanitation stations, transportation to medical facilities, and financial stability to pay for any type of procedure. As one can observe from studying the Honduran health care system, there is a significant discrepancy between the quality of care given to its citizens based purely among class status.

In order to evaluate the quality of life of citizens from three different regions in Honduras, a survey from the Honduras Outreach Medical Brigada Relief Effort was taken[1]. This survey assessed the distance it takes to travel to a clinic, when citizens see a physician or dentist, specialized procedures available, and the barriers that keep citizens from seeking health or dental care. After observing the results of the survey studying the access and barriers presenting to Hondurans concerning health care, there were four main reasons Hondurans listed for seeking out healthcare. 95% of respondents said "feeling ill", 51% said preventive care, 43% said to obtain medication and 17% said prenatal care was their reason for visiting a healthcare facility[1]. As one can see by the numbers, almost all of the respondents said they seek health care when ill. On the other hand, a small fraction of the population seeks prenatal care or preventative care. The limitations to health care in Honduras have made prenatal care a rarity, while in America and other countries this is commonplace. Only about half of Hondurans (giving consideration this study included both rural and urban areas) seek healthcare for preventative measures.

One aspect of the survey is to analyze the proportion of the population for each town that are "never able" to obtain "blood tests, radiography, or see a specialist." Questionnaires were also given to examine how many were able to receive care from a physician within the past twelve months and the travel time it takes one to reach the physician. When comparing results from the three different areas, 70% of citizens from the rural town of Lomitas were not able to see a physician from the last year, which is staggering higher than the 28% of those living in the urban town of Coyoles who did not see a physician within the last year[1]. This data shows that there is a disparity among access throughout rural and urban regions of Honduras. Adding to this, the travel time for those living in an urban area with more resources, was less than 30 minutes for 59%. This can be compared to the 58% of people who had a greater than 3- hour travel time from Lomitas. The conclusion from this is that these statistics on travel time and physician access prove there is a significant health disparity between rural and urban regions of Honduras.

By purely comparing the travel times it takes for citizens to access a physician, one can observe that there is a discrepancy between the accessibility of health care providers for the lower class compared to the wealthier class. To hit this observation home, access to specialists, blood tests and radiography are also compared between classes, which shows how the lower class, who are supported from the public sector, are provided with less quality care, less resources, and less accessible than the wealthy private sector.

Primary Research

A small-scale survey similar to the one given in Honduras was created and the results

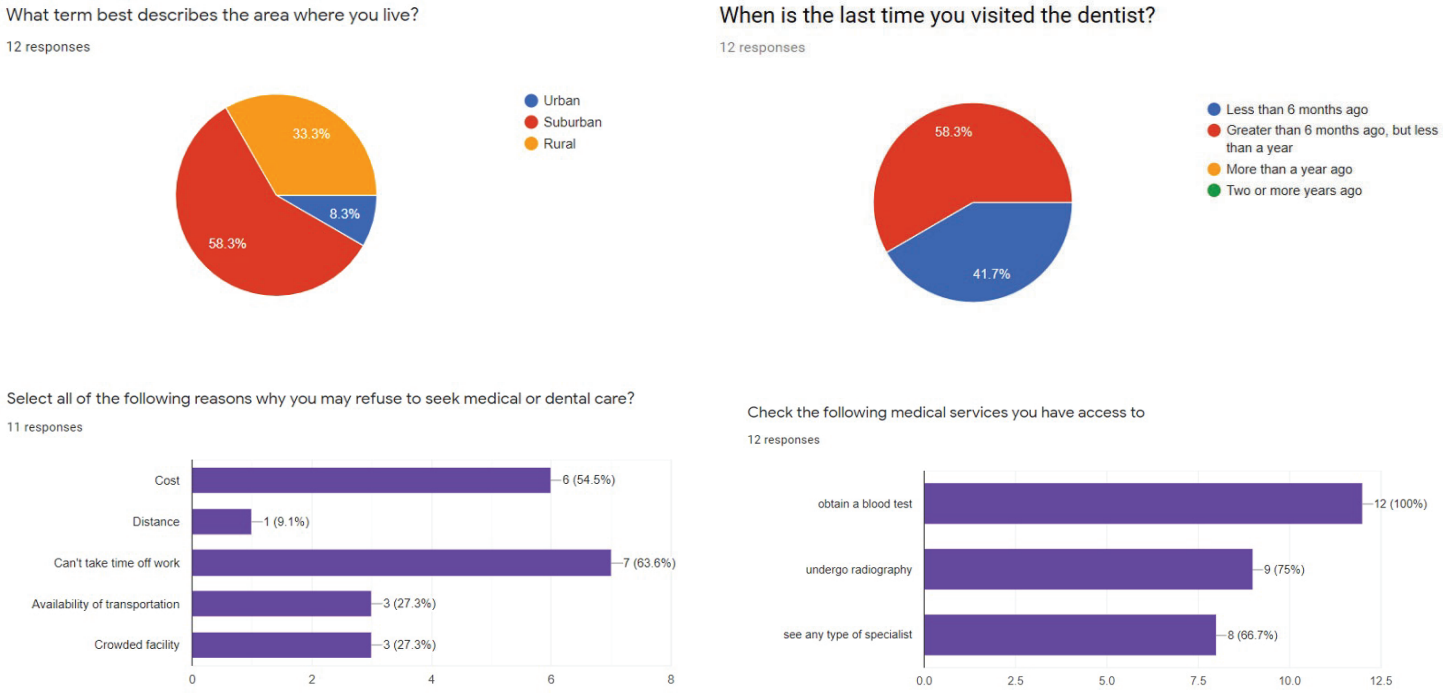

Figure 1. Survey questions and responses

were compared to the trends of the published study. First, respondents were categorized based on their geographical location (urban, suburban, or rural). Then, questions evaluated the distance to the nearest hospital, the last time they saw the dentist, why they refuse to seek medical or dental care, and the medical services they have access to. As seen in the figure below, 8.3% of the respondents were urban, with the majority of 58.3% being categorized as rural. Therefore, the responses greatly reflect the rural American lifestyle. The majority of respondents at 83.3% stated that there was a less than thirty-minute drive to the nearest hospital. This means that medical facilities are easily accessed by Americans, if at least regarding simply distance. Contrary to Pearson, when evaluating dental visits, all responses said they either saw a dentist less than six months ago or greater than six months ago, but less than a year ago. This is unexpected due to lack of accessibility of dental insurance and it was predicted that respondents would not have seen a dentist in over a year.

First, for both the rural Americans and the rural Hondurans, "cost" and "cannot take time off work" were significant reasons for not being able to seek medical or dental care. This suggests those with lower income or those living paycheck to paycheck are unable to afford decent healthcare whether that's based on not only physical costs, but also loss of wages due to the time they are not working. The parallels between citizens of two very different regions of the world, show the underlying barriers that impact the decision on whether or not to obtain medical services. However, the discrepancy between the quality of life regarding access to health care can be seen between these two countries in the last figure. It is unexpected to see that 100% of the respondents in the survey stated that they had access to obtain a blood test. The responses for undergo radiography and see a specialist were also well above average at 75% and 66.7% respectively. For the rural town of La Hicaca in Honduras, only 28% of respondents were able to obtain a blood test and 34% had access to a specialist.

Once these various factors, such as distance, demographics, and the availability of

preventative care, and the specific healthcare model adopted by a country are taken into consideration, the underlying ethical issue behind why healthcare disparities exist in the first place can be seen. While a country's healthcare model may innately put the lower and middle classes at a distinct disadvantage, by not providing information to the general public on these models or promoting healthcare education to the masses, the government can keep these disparities in place for years to come. The lack of education and accessibility is an ethical issue that can be seen in even the most industrialized countries, such as America and Germany. Only open dialogue between the government, citizens, and researchers can offer a discourse on ways to limit healthcare disparities between socioeconomic classes.

Competing Interests

The author declares no competing interests.

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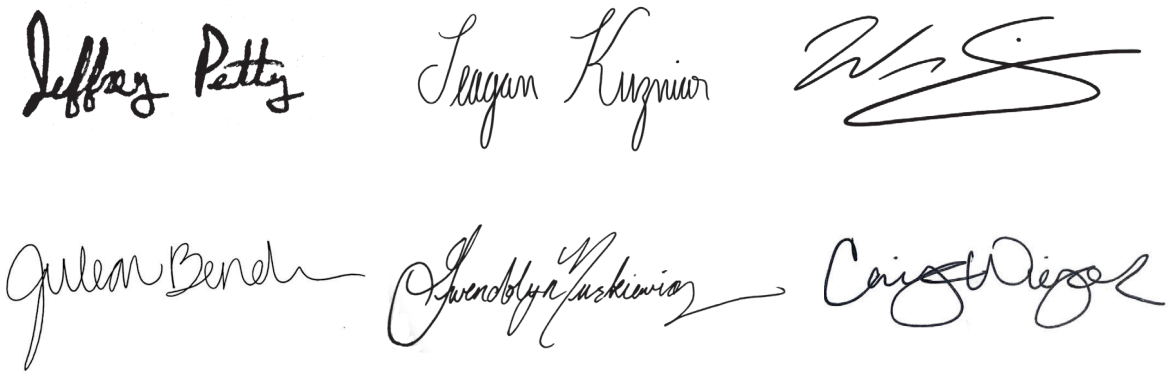
How to Cite This Article:

Hodak, B.N., Nicholson, R.K. (2021). Health care disparities around the globe. *Mountaineer Undergraduate Research Review*, *6*(1), 22-30.

Acknowledgements

We at MURR would like to dedicate the first issue of Volume 6 to the hardworking undergraduate researchers at WVU, without whom our publication would not exist. We would like to extend our gratitude to the Office of Undergraduate Research (UGR) for its continued support of MURR over the past 2 years since its re-establishment. We would like to thank our project advisors, Kevin Walden and Dr. Michelle Richards-Babb, for their constant support and work dedicated to MURR's success in publishing undergraduate research. We would like to thank our other faculty advisor, Ian Harmon, who serves as a scholarly communications librarian for WVU Libraries. Furthermore, we would like to thank Dr. Ken Blemings, Colleen Good, Dr. Eugen Nagy and Dr. Dana Huebert Lima from the Honors College and Honors EXCEL program for their support. We would also like to thank our faculty reviewers for MURR Volume 6, Issue 1: Drs. Elizabeth Claydon, Ed Brzostek, Corey Colyer, Dimitra Pyrialakou, Michael McCawley and Amy Hirshman. We extend our gratitude to the WVU administration who supported the efforts of the undergraduate researchers, student-authors, and project drivers for this issue, including President Gordon Gee and those who contributed prefatory letters: Dr. Melanie Page, Associate Vice Provost for Creative and Scholarly Activities for the WVU Research Office, and members of the WVU Honors College and ASPIRE Office, Amy Cyphert and Cate Johnson. Finally, MURR is indebted to the students who have worked tirelessly to make this publication a reality. We would like to extend our sincerest gratitude to Editorial Review Board members, copy editors, student authors, cover art contest participants, and our graduate advisor, David Sokolov.

Sincerely,



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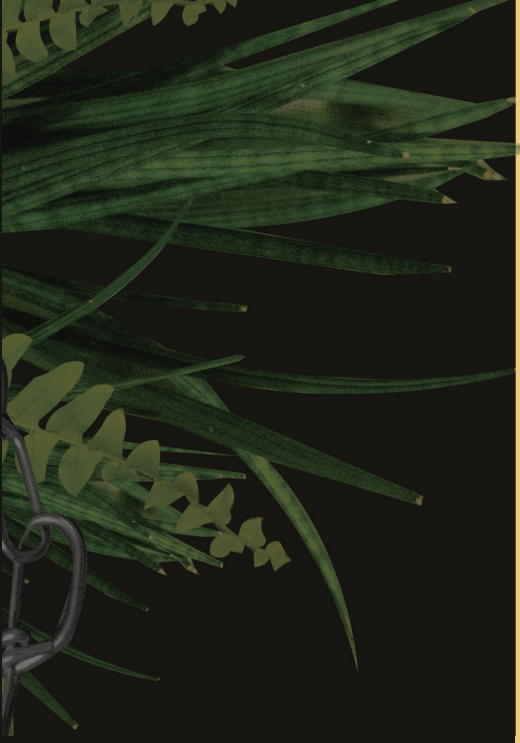

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